RECERTIFICATION OF

PROVISIONALLY ACCREDITED LEVEES
P141 AND P143
on
STEVENS CREEK
in

MOUNTAIN VIEW, CALIFORNIA
(Community No. 060347)

May 2009

CITY OF MOUNTAIN VIEW

Santa Clara Valley Water District

Schaaf & Wheeler
CONSULTING CIVIL ENGINEERS

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May 14, 2009

Mr. Eric Simmons, CFM
National Flood Insurance Program
FEMA Region IX
1111 Broadway, Suite 1200
Oakland, CA 94609
(510) 627-7029

Subject: **Recertification of Provisionally Accredited Levees P141 and P143 on Stevens Creek in Mountain View, California**

Dear Mr. Simmons:

On behalf of the Santa Clara Valley Water District and City of Mountain View, I hereby submit the documentation and engineering analyses necessary to obtain full accreditation for Levees P141 and P143 from Highway 101 to Crittenden Lane in Mountain View. It is my professional opinion that the subject levees meet the requirements of 44 CFR §65.10.

Enclosed is an application for the recertification of the levees on the east and west banks of Stevens Creek between Highway 101 and the tidally influenced bayfront area in Mountain View, CA. (The limit is Crittenden Lane). Our submittal is organized as follows:

Tab 1	MT-2 Forms 1, 2, and 3
Tab 2	Annotated FIRM and FIS Profile
Tab 3	Survey Report and LiDAR Metadata
Tab 4	Topographic Work Maps
Tab 5	Record Drawings
Tab 6	Freeboard Evaluation
Tab 7	Engineering Analyses
Tab 8	Interior Drainage
Tab 9	Operation and Maintenance

The following documentation and analyses are bound separately and enclosed with this application:

Geotechnical Investigation (AMEC Geomatrix, 2009)

Digital HEC-RAS model on CD (Schaaf & Wheeler, 2009)

Thank you very much for accepting our levee recertification package for Stevens Creek in Mountain View. Please direct technical questions regarding this application to Liza McNulty or me.

Very truly yours,
SCHAAF & WHEELER

Charles D. Anderson, PE
President

Enclosures

cc: Robert van den Berg, Santa Clara Valley Water District
Sean Rose, City of Mountain View

TAB 1

U.S. DEPARTMENT OF HOMELAND SECURITY - FEDERAL EMERGENCY MANAGEMENT AGENCY

OVERVIEW & CONCURRENCE FORM

O.M.B No. 1660-0016
Expires: 12/31/2010

PAPERWORK BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 1 hour per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing, reviewing, and submitting the form. You are not required to respond to this collection of information unless a valid OMB control number appears in the upper right corner of this form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, U.S. Department of Homeland Security, Federal Emergency Management Agency, 500 C Street, SW, Washington DC 20472, Paperwork Reduction Project (1660-0016). Submission of the form is required to obtain or retain benefits under the National Flood Insurance Program. **Please do not send your completed survey to the above address.**

A. REQUESTED RESPONSE FROM DHS-FEMA

This request is for a (check one):

☐ CLOMR: A letter from DHS-FEMA commenting on whether a proposed project, if built as proposed, would justify a map revision, or proposed hydrology changes (See 44 CFR Ch. 1, Parts 60, 65 & 72).

☒ LOMR: A letter from DHS-FEMA officially revising the current NFIP map to show the changes to floodplains, regulatory floodway or flood elevations. (See 44 CFR Ch. 1, Parts 60, 65 & 72)

B. OVERVIEW

1. The NFIP map panel(s) affected for all impacted communities is (are):

Community No.	Community Name	State	Map No.	Panel No.	Effective Date
Ex: 480301 480287	City of Katy Harris County	TX TX	480301 48201C	0005D 0220G	02/08/83 09/28/90
060347	City of Mountain View, California	CA	06085C	0037H	05/18/09

2. a. Flooding Source: Stevens Creek

   b. Types of Flooding: ☒ Riverine ☐ Coastal ☐ Shallow Flooding (e.g., Zones AO and AH)

   ☐ Alluvial fan ☐ Lakes ☐ Other (Attach Description)

3. Project Name/Identifier: Recertification of Provisionally Accredited Levees P141 and P143

4. FEMA zone designations affected: A (choices: A, AH, AO, A1-A30, A99, AE, AR, V, V1-V30, VE, B, C, D, X)

5. Basis for Request and Type of Revision:

   a. The basis for this revision request is (check all that apply)

   ☐ Physical Change ☐ Improved Methodology/Data ☐ Regulatory Floodway Revision ☐ Base Map Changes

   ☐ Coastal Analysis ☐ Hydraulic Analysis ☐ Hydrologic Analysis ☐ Corrections

   ☐ Weir-Dam Changes ☒ Levee Certification ☐ Alluvial Fan Analysis ☐ Natural Changes

   ☐ New Topographic Data ☐ Other (Attach Description)

   Note: A photograph and narrative description of the area of concern is not required, but is very helpful during review.

   b. The area of revision encompasses the following structures (check all that apply)

   Structures: ☐ Channelization ☒ Levee/Floodwall ☒ Bridge/Culvert

   ☐ Dam ☐ Fill ☐ Other (Attach Description)

C. REVIEW FEE

Has the review fee for the appropriate request category been included? ☐ Yes Fee amount: $_____

☒ No, Attach Explanation

Please see the DHS-FEMA Web site at http://www.fema.gov/plan/prevent/fhm/frm_fees.shtm **for Fee Amounts and Exemptions.**

D. SIGNATURE

All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Name: Chris Elias	Company: Santa Clara Valley Water District	
Mailing Address: 5750 Almaden Expressway San Jose, CA 95118-3614	Daytime Telephone No.: (408) 265-2607 Ext 2379	Fax No.: (408) 979-5666
	E-Mail Address: celias@valleywater.org	
Signature of Requester (required):	Date:	

As the community official responsible for floodplain management, I hereby acknowledge that we have received and reviewed this Letter of Map Revision (LOMR) or conditional LOMR request. Based upon the community's review, we find the completed or proposed project meets or is designed to meet all of the community floodplain management requirements, including the requirement that no fill be placed in the regulatory floodway, and that all necessary Federal, State, and local permits have been, or in the case of a conditional LOMR, will be obtained. In addition, we have determined that the land and any existing or proposed structures to be removed from the SFHA are or will be reasonably safe from flooding as defined in 44CFR 65.2(c), and that we have available upon request by FEMA, all analyses and documentation used to make this determination.

Community Official's Name and Title: Cathy Lazarus, Public Works Director	Community Name: City of Mountain View, CA	
Mailing Address: P.O. Box 7540 Mountain View, CA 94039-7540	Daytime Telephone No.: (650) 903-6311	Fax No.: (650) 903-6499
	E-Mail Address: clazarus@mountainview.gov	
Community Official's Signature (required):	Date:	

CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR

This certification is to be signed and sealed by a licensed land surveyor, registered professional engineer, or architect authorized by law to certify elevation information data, hydrologic and hydraulic analysis, and any other supporting information as per NFIP regulations paragraph 65.2(b) and as described in the MT-2 Forms Instructions. All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Certifier's Name: Charles D. Anderson, P.E.	License No.: CA C43776	Expiration Date: 6/30/09
Company Name: Schaaf & Wheeler, Consulting Civil Engineers	Telephone No.: (408) 246-4848	Fax No.: (408) 246-5624
Signature: Charles D. Anderson		Date: 5/12/09

Ensure the forms that are appropriate to your revision request are included in your submittal.

Form Name and (Number)	Required if ...
☒ Riverine Hydrology and Hydraulics Form (Form 2)	New or revised discharges or water-surface elevations
☒ Riverine Structures Form (Form 3)	Channel is modified, addition/revision of bridge/culverts, addition/revision of levee/floodwall, addition/revision of dam
☐ Coastal Analysis Form (Form 4)	New or revised coastal elevations
☐ Coastal Structures Form (Form 5)	Addition/revision of coastal structure
☐ Alluvial Fan Flooding Form (Form 6)	Flood control measures on alluvial fans

REGISTERED PROFESSIONAL ENGINEER
CHARLES D. ANDERSON
No. 43776
EXP. 6/30/09
CIVIL
STATE OF CALIFORNIA

Seal (Optional)

U.S. DEPARTMENT OF HOMELAND SECURITY - FEDERAL EMERGENCY MANAGEMENT AGENCY

RIVERINE HYDROLOGY & HYDRAULICS FORM

O.M.B No. 1660-0016
Expires: 12/31/2010

PAPERWORK REDUCTION ACT

Public reporting burden for this form is estimated to average 3.25 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing, reviewing, and submitting the form. You are not required to respond to this collection of information unless a valid OMB control number appears in the upper right corner of this form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, U.S. Department of Homeland Security, Federal Emergency Management Agency, 500 C Street, SW, Washington DC 20472, Paperwork Reduction Project (1660-0016). Submission of the form is required to obtain or retain benefits under the National Flood Insurance Program. **Please do not send your completed survey to the above address.**

Flooding Source: Stevens Creek
Note: Fill out one form for each flooding source studied

A. HYDROLOGY

1. Reason for New Hydrologic Analysis (check all that apply)

☒ Not revised (skip to section B) ☐ No existing analysis ☐ Improved data
☐ Alternative methodology ☐ Proposed Conditions (CLOMR) ☐ Changed physical condition of watershed

2. Comparison of Representative 1%-Annual-Chance Discharges

Location	Drainage Area (Sq. Mi.)	Effective/FIS (cfs)	Revised (cfs)

3. Methodology for New Hydrologic Analysis (check all that apply)

☐ Statistical Analysis of Gage Records ☐ Precipitation/Runoff Model
☐ Regional Regression Equations ☐ Other (please attach description)

Please enclose all relevant models in digital format, maps, computations (including computation of parameters) and documentation to support the new analysis.

4. Review/Approval of Analysis

If your community requires a regional, state, or federal agency to review the hydrologic analysis, please attach evidence of approval/review.

5. Impacts of Sediment Transport on Hydrology

Was sediment transport considered? ☐ Yes ☐ No If yes, then fill out Section F (Sediment Transport) of Form 3. If No, then attach your explanation for why sediment transport was not considered.

B. HYDRAULICS

1. Reach to be Revised

	Description	Cross Section	Water-Surface Elevations (ft.) Effective	Proposed/Revised
Downstream Limit	Inboard Levee at San Francisco Bay	13	-------	9.8 feet NAVD
Upstream Limit	Bayshore Freeway (U.S. 101)	14323	35.9 feet NAVD	36.0 feet NAVD

2. Hydraulic Method/Model Used

HEC-RAS

B. HYDRAULICS (CONTINUED)

3. Pre-Submittal Review of Hydraulic Models

DHS-FEMA has developed two review programs, CHECK-2 and CHECK-RAS, to aid in the review of HEC-2 and HEC-RAS hydraulic models, respectively. These review programs may help verify that the hydraulic estimates and assumptions in the model data are in accordance with NFIP requirements, and that the data are comparable with the assumptions and limitations of HEC-2/HEC-RAS. CHECK-2 and CHECK-RAS identify areas of potential error or concern. **These tools do not replace engineering judgment.** CHECK-2 and CHECK-RAS can be downloaded from http://www.fema.gov/plan/prevent/fhm/frm_soft.shtm. We recommend that you review your HEC-2 and HEC-RAS models with CHECK-2 and CHECK-RAS. Review of your submittal and resolution of valid modeling discrepancies may result in reduced review time.

4. Models Submitted

Models Submitted	Natural Run		Floodway Run		Datum
Duplicate Effective Model*	File Name:	Plan Name:	File Name:	Plan Name:	____
Corrected Effective Model*	File Name:	Plan Name:	File Name:	Plan Name:	____
Existing or Pre-Project Conditions Model	File Name: FEMA	Plan Name: stevens	File Name:	Plan Name:	NAVD
Revised or Post-Project Conditions Model	File Name:	Plan Name:	File Name:	Plan Name:	____
Other - (attach description)	File Name:	Plan Name:	File Name:	Plan Name:	____

* For details, refer to the corresponding section of the instructions.

☒ Digital Models Submitted? (Required)

C. MAPPING REQUIREMENTS

A **certified topographic map** must be submitted showing the following information (where applicable): the boundaries of the effective, existing, and proposed conditions 1%-annual-chance floodplain (for approximate Zone A revisions) or the boundaries of the 1%- and 0.2%-annual-chance floodplains and regulatory floodway (for detailed Zone AE, AO, and AH revisions); location and alignment of all cross sections with stationing control indicated; stream, road, and other alignments (e.g., dams, levees, etc.); current community easements and boundaries; boundaries of the requester's property; certification of a registered professional engineer registered in the subject State; location and description of reference marks; and the referenced vertical datum (NGVD, NAVD, etc.).

☐ Digital Mapping (GIS/CADD) Data Submitted

Note that the boundaries of the existing or proposed conditions floodplains and regulatory floodway to be shown on the revised FIRM and/or FBFM must tie-in with the effective floodplain and regulatory floodway boundaries. Please attach **a copy of the effective FIRM and/or FBFM,** annotated to show the boundaries of the revised 1%- and 0.2%-annual-chance floodplains and regulatory floodway that tie-in with the boundaries of the effective 1%- and 0.2%-annual-chance floodplain and regulatory floodway at the upstream and downstream limits of the area of revision.

☒ Annotated FIRM and/or FBFM (Required)

D. COMMON REGULATORY REQUIREMENTS*

1. For LOMR/CLOMR requests, do Base Flood Elevations (BFEs) increase? ☐ Yes ☒ No

   a. For CLOMR requests, if either of the following is true, please submit **evidence of compliance with Section 65.12 of the NFIP regulations**:
      - The proposed project encroaches upon a regulatory floodway and would result in increases above 0.00 foot.
      - The proposed project encroaches upon a SFHA with or without BFEs established and would result in increases above 1.00 foot.

   b. For LOMR requests, does this request require property owner notification and acceptance of BFE increases? ☐ Yes ☒ No
      If Yes, please attach **proof of property owner notification and acceptance (if available)**. Elements of and examples of property owner notification can be found in the MT-2 Form 2 Instructions.

2. Does the request involve the placement or proposed placement of fill? ☐ Yes ☒ No

   If Yes, the community must be able to certify that the area to be removed from the special flood hazard area, to include any structures or proposed structures, meets all of the standards of the local floodplain ordinances, and is reasonably safe from flooding in accordance with the NFIP regulations set forth at 44 CFR 60.3(a)(3), 65.5(a)(4), and 65.6(a)(14). Please see the MT-2 instructions for more information.

3. For LOMR requests, is the regulatory floodway being revised? ☐ Yes ☒ No

   If Yes, attach **evidence of regulatory floodway revision notification**. As per Paragraph 65.7(b)(1) of the NFIP Regulations, notification is required for requests involving revisions to the regulatory floodway. (Not required for revisions to approximate 1%-annual-chance floodplains [studied Zone A designation] unless a regulatory floodway is being added. Elements and examples of regulatory floodway revision notification can be found in the MT-2 Form 2 Instructions.)

4. For LOMR/CLOMR requests, does this request have the potential to impact an endangered species? ☐ Yes ☒ No

   If Yes, please submit documentation to the community to show that you have complied with Sections 9 and 10 of the Endangered Species Act (ESA). Section 9 of the ESA prohibits anyone from "taking" or harming an endangered species. If an action might harm an endangered species, a permit is required from U.S. Fish and Wildlife Service or National Marine Fisheries Service under Section 10 of the ESA.

   For actions authorized, funded, or being carried out by Federal or State agencies, please submit documentation from the agency showing its compliance with Section 7(a)(2) of the ESA.

* Not inclusive of all applicable regulatory requirements. For details, see 44 CFR parts 60 and 65.

U.S. DEPARTMENT OF HOMELAND SECURITY - FEDERAL EMERGENCY MANAGEMENT AGENCY

RIVERINE STRUCTURES FORM

O.M.B No. 1660-0016
Expires: 12/31/2010

PAPERWORK REDUCTION ACT

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Flooding Source: Stevens Creek
Note: Fill out one form for each flooding source studied

A. GENERAL

Complete the appropriate section(s) for each Structure listed below:

Channelization.....complete Section B
Bridge/Culvert.....complete Section C
Dam/Basin .....complete Section D
Levee/Floodwall .....complete Section E
Sediment Transport.....complete Section F (if required)

Description Of Structure

1. **Name of Structure: Crittenden Lane Footbridge**

   Type (check one): ☐ Channelization ☒ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam/Basin

   Location of Structure: 3,750 feet upstream Inboard Levee of San Francisco Bay

   Downstream Limit/Cross Section: 8415

   Upstream Limit/Cross Section: 8439

2. **Name of Structure: Provisionally Accredited Levee P141**

   Type (check one): ☐ Channelization ☐ Bridge/Culvert ☒ Levee/Floodwall ☐ Dam/Basin

   Location of Structure: West Bank of Stevens Creek

   Downstream Limit/Cross Section: 8415

   Upstream Limit/Cross Section: 14137

3. **Name of Structure: Provisionally Accredited Levee P143**

   Type (check one) ☐ Channelization ☐ Bridge/Culvert ☒ Levee/Floodwall ☐ Dam/Basin

   Location of Structure: East Bank of Stevens Creek

   Downstream Limit/Cross Section: 8439

   Upstream Limit/Cross Section: 14168

NOTE: For more structures, attach additional pages as needed.

B. CHANNELIZATION

Flooding Source:

Name of Structure:

1. Accessory Structures

The channelization includes (check one):

- ☐ Levees [Attach Section E (Levee/Floodwall)]
- ☐ Superelevated sections
- ☐ Debris basin/detention basin [Attach Section D (Dam/Basin)]
- ☐ Other (Describe):
- ☐ Drop structures
- ☐ Transitions in cross sectional geometry
- ☐ Energy dissipator

2. Drawing Checklist

Attach the plans of the channelization certified by a registered professional engineer, as described in the instructions.

3. Hydraulic Considerations

The channel was designed to carry (cfs) and/or the -year flood.

The design elevation in the channel is based on (check one):

☐ Subcritical flow ☐ Critical flow ☐ Supercritical flow ☐ Energy grade line

If there is the potential for a hydraulic jump at the following locations, check all that apply and attach an explanation of how the hydraulic jump is controlled without affecting the stability of the channel.

☐ Inlet to channel ☐ Outlet of channel ☐ At Drop Structures ☐ At Transitions
☐ Other locations (specify):

4. Sediment Transport Considerations

Was sediment transport considered? ☐ Yes ☐ No If Yes, then fill out Section F (Sediment Transport).
If No, then attach your explanation for why sediment transport was not considered.

C. BRIDGE/CULVERT

Flooding Source: Stevens Creek

Name of Structure: Crittenden Lane Pedestrian Bridge

1. This revision reflects (check one):

- ☐ Bridge/culvert not modeled in the FIS
- ☐ Modified bridge/culvert previously modeled in the FIS
- ☒ Revised analysis of bridge/culvert previously modeled in the FIS

2. Hydraulic model used to analyze the structure (e.g., HEC-2 with special bridge routine, WSPRO, HY8): HEC-RAS
If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structures. Attach justification.

3. Attach plans of the structures certified by a registered professional engineer. The plan detail and information should include the following (check the information that has been provided):

- ☒ Dimensions (height, width, span, radius, length)
- ☐ Shape (culverts only)
- ☒ Material
- ☒ Beveling or Rounding
- ☒ Wing Wall Angle
- ☒ Skew Angle
- ☒ Distances Between Cross Sections
- ☒ Erosion Protection
- ☒ Low Chord Elevations – Upstream and Downstream
- ☒ Top of Road Elevations – Upstream and Downstream
- ☒ Structure Invert Elevations – Upstream and Downstream
- ☒ Stream Invert Elevations – Upstream and Downstream
- ☒ Cross-Section Locations

4. Sediment Transport Considerations

Was sediment transport considered? ☐ Yes ☒ No If yes, then fill out Section F (Sediment Transport).
If No, then attach your explanation for why sediment transport was not considered.

D. DAM/BASIN

Flooding Source:

Name of Structure:

1. This request is for (check one): ☐ Existing dam ☐ New dam ☐ Modification of existing dam

2. The dam was designed by (check one): ☐ Federal agency ☐ State agency ☐ Local government agency ☐ Private organization

   Name of the agency or organization:

3. The Dam was permitted as (check one):

   a. ☐ Federal Dam ☐ State Dam

      Provide the permit or identification number (ID) for the dam and the appropriate permitting agency or organization

      Permit or ID number Permitting Agency or Organization

   b. ☐ Local Government Dam ☐ Private Dam

      Provided related drawings, specification and supporting design information.

4. Does the project involve revised hydrology? ☐ Yes ☐ No

   If Yes, complete the Riverine Hydrology & Hydraulics Form (Form 2).

   Was the dam/basin designed using critical duration storm?

   ☐ Yes, provide supporting documentation with your completed Form 2.

   ☐ No, provide a written explanation and justification for not using the critical duration storm.

5. Does the submittal include debris/sediment yield analysis? ☐ Yes ☐ No

   If yes, then fill out Section F (Sediment Transport).
   If No, then attach your explanation for why debris/sediment analysis was not considered.

6. Does the Base Flood Elevation behind the dam or downstream of the dam change?

   ☐ Yes ☐ No If Yes, complete the Riverine Hydrology & Hydraulics Form (Form 2) and complete the table below.

   Stillwater Elevation Behind the Dam

FREQUENCY (% annual chance)	FIS	REVISED
10-year (10%)		
50-year (2%)		
100-year (1%)		
500-year (0.2%)		
Normal Pool Elevation		

7. Please attach a copy of the formal Operation and Maintenance Plan

E. LEVEE/FLOODWALL

1. System Elements

a. This Levee/Floodwall analysis is based on (check one):

☐ upgrading of an existing levee/floodwall system
☐ a newly constructed levee/floodwall system
☒ reanalysis of an existing levee/floodwall system

b. Levee elements and locations are (check one):

☒ earthen embankment, dike, berm, etc.	Station 14137 to 8439
☒ structural floodwall	Station 12694 to 11170
☐ Other (describe):	Station to

c. Structural Type (check one):

☒ monolithic cast-in place reinforced concrete
☐ reinforced concrete masonry block
☐ sheet piling
☐ Other (describe):

d. Has this levee/floodwall system been certified by a Federal agency to provide protection from the base flood?

☐ Yes ☒ No

If Yes, by which agency?

e. Attach certified drawings containing the following information (indicate drawing sheet numbers):

1. Plan of the levee embankment and floodwall structures.	Sheet Numbers: 4-9
2. A profile of the levee/floodwall system showing the Base Flood Elevation (BFE), levee and/or wall crest and foundation, and closure locations for the total levee system.	Sheet Numbers: 4-9
3. A profile of the BFE, closure opening outlet and inlet invert elevations, type and size of opening, and kind of closure.	Sheet Numbers: n/a
4. A layout detail for the embankment protection measures.	Sheet Numbers: 15-24
5. Location, layout, and size and shape of the levee embankment features, foundation treatment, floodwall structure, closure structures, and pump stations.	Sheet Numbers: 15-24

2. Freeboard

a. The minimum freeboard provided above the BFE is:

Riverine

3.0 feet or more at the downstream end and throughout	☒ Yes	☐ No
3.5 feet or more at the upstream end	☒ Yes	☐ No
4.0 feet within 100 feet upstream of all structures and/or constrictions	☒ Yes	☐ No

Coastal

1.0 foot above the height of the one percent wave associated with the 1%-annual-chance stillwater surge elevation or maximum wave runup (whichever is greater).	☐ Yes	☐ No
2.0 feet above the 1%-annual-chance stillwater surge elevation	☐ Yes	☐ No

2. Freeboard (continued)

Please note, occasionally exceptions are made to the minimum freeboard requirement. If an exception is requested, attach documentation addressing Paragraph 65.10(b)(1)(ii) of the NFIP Regulations.

If No is answered to any of the above, please attach an explanation.

b. Is there an indication from historical records that ice-jamming can affect the BFE? ☐ Yes ☒ No

If Yes, provide ice-jam analysis profile and evidence that the minimum freeboard discussed above still exists.

3. Closures

a. Openings through the levee system (check one): ☐ exists ☒ does not exist

If opening exists, list all closures:

Channel Station	Left or Right Bank	Opening Type	Highest Elevation for Opening Invert	Type of Closure Device

(Extend table on an added sheet as needed and reference)

Note: Geotechnical and geologic data

In addition to the required detailed analysis reports, data obtained during field and laboratory investigations and used in the design analysis for the following system features should be submitted in a tabulated summary form. (Reference U.S. Army Corps of Engineers [USACE] EM-1110-2-1906 Form 2086.)

4. Embankment Protection

a. The maximum levee slope landside is: 2:1

b. The maximum levee slope floodside is: 2:1

c. The range of velocities along the levee during the base flood is: 2.5 fps (min.) to 5.3 fps (max.)

d. Embankment material is protected by (describe what kind): Vegetation and Selective Rock Revetment

e. Riprap Design Parameters (check one): ☒ Velocity ☐ Tractive stress
Attach references

Reach		Sideslope	Flow Depth	Velocity	Curve or Straight	Stone Riprap			Depth of Toedown
						D_{100}	D_{50}	Thickness	
Sta	to								
Sta	to								
Sta	to								
Sta	to								
Sta	to								
Sta	to								

(Extend table on an added sheet as needed and reference each entry)

4. Embankment Protection (continued)

f. Is a bedding/filter analysis and design attached? ☐ Yes ☒ No

g. Describe the analysis used for other kinds of protection used (include copies of the design analysis):

See Chapter 8 of enclosed Geotechnical Investigation by AMEC Geomatrix, Inc.

Attach engineering analysis to support construction plans.

5. Embankment And Foundation Stability

a. Identify locations and describe the basis for selection of critical location for analysis:
See Chapter 7 of enclosed Geotechnical Investigation by AMEC Geomatrix, Inc.

☐ Overall height: Sta. ; height ft.

☐ Limiting foundation soil strength:

Sta. , depth to

strength ϕ = degrees, c = psf

slope: SS = (h) to (v)

(Repeat as needed on an added sheet for additional locations)

b. Specify the embankment stability analysis methodology used (e.g., circular arc, sliding block, infinite slope, etc.):

Two-dimensional force and moment limit-equilibrium method (SLOPE/W)

c. Summary of stability analysis results:

Case	Loading Conditions	Critical Safety Factor	Criteria (Min.)
I	End of construction	2.90	1.3
II	Sudden drawdown	2.27	1.0
III	Critical flood stage	2.76	1.4
IV	Steady seepage at flood stage	2.76	1.4
VI	Earthquake (Case I)	1.20	1.0

(Reference: USACE EM-1110-2-1913 Table 6-1)

d. Was a seepage analysis for the embankment performed? ☒ Yes ☐ No

If Yes, describe methodology used: Two-dimensional finite element (SEEP/W)

e. Was a seepage analysis for the foundation performed? ☒ Yes ☐ No

f. Were uplift pressures at the embankment landside toe checked? ☒ Yes ☐ No

g. Were seepage exit gradients checked for piping potential? ☒ Yes ☐ No

h. The duration of the base flood hydrograph against the embankment is 16 hours.

Attach engineering analysis to support construction plans.

6. Floodwall And Foundation Stability

a. Describe analysis submittal based on Code (check one):

☐ UBC (1988) or ☒ Other (specify): See Chapter 7.4.5 of enclosed Geotechnical Investigation

b. Stability analysis submitted provides for:

☒ Overturning ☒ Sliding If not, explain:

c. Loading included in the analyses were:

☐ Lateral earth @ P_A = psf; P_p = psf

☐ Surcharge-Slope @ , ☐ surface psf

☐ Wind @ P_w = psf

☐ Seepage (Uplift); ☐ Earthquake @ P_{eq} = %g

☐ 1%-annual-chance significant wave height: ft.

☐ 1%-annual-chance significant wave period: sec.

d. Summary of Stability Analysis Results: Factors of Safety.

Itemize for each range in site layout dimension and loading condition limitation for each respective reach.

Loading Condition	Criteria (Min)		Sta	To	Sta	To
	Overturn	Sliding	Overturn	Sliding	Overturn	Sliding
Dead & Wind	1.5	1.5	8.6	40.7		
Dead & Soil	1.5	1.5				
Dead, Soil, Flood, & Impact	1.5	1.5	1.8	2.5		
Dead, Soil, & Seismic	1.3	1.3	3.9	10.0		

(Ref: FEMA 114 Sept 1986; USACE EM 1110-2-2502)

(Note: Extend table on an added sheet as needed and reference)

e. Foundation bearing strength for each soil type:

Bearing Pressure	Sustained Load (psf)	Short Term Load (psf)
Computed design maximum	2,187	
Maximum allowable	2,500	

f. Foundation scour protection ☐ is, ☒ is not provided. If provided, attach explanation and supporting documentation:

Attach engineering analysis to support construction plans.

7. Settlement

a. Has anticipated potential settlement been determined and incorporated into the specified construction elevations to maintain the established freeboard margin? ☒ Yes ☐ No

b. The computed range of settlement is 0.08 ft. to 0.17 ft.

c. Settlement of the levee crest is determined to be primarily from :

☐ Foundation consolidation
☐ Embankment compression
☒ Other (Describe):

d. Differential settlement of floodwalls ☐ has ☒ has not been accommodated in the structural design and construction.

Attach engineering analysis to support construction plans.

8. Interior Drainage

a. Specify size of each interior watershed:

Draining to pressure conduit: 205 acres
Draining to ponding area: 193 acres

b. Relationships Established

Ponding elevation vs. storage	☒ Yes	☐ No
Ponding elevation vs. gravity flow	☒ Yes	☐ No
Differential head vs. gravity flow	☒ Yes	☐ No

c. The river flow duration curve is enclosed: ☒ Yes ☐ No

d. Specify the discharge capacity of the head pressure conduit: 150 cfs

e. Which flooding conditions were analyzed?

• Gravity flow (Interior Watershed)	☒ Yes	☐ No
• Common storm (River Watershed)	☒ Yes	☐ No
• Historical ponding probability	☐ Yes	☒ No
• Coastal wave overtopping	☐ Yes	☒ No

If No for any of the above, attach explanation.

f. Interior drainage has been analyzed based on joint probability of interior and exterior flooding and the capacities of pumping and outlet facilities to provide the established level of flood protection. ☒ Yes ☐ No

If No, attach explanation.

g. The rate of seepage through the levee system for the base flood is 0 cfs

h. The length of levee system used to drive this seepage rate in item g: ft.

8. Interior Drainage (continued)

i. Will pumping plants be used for interior drainage? ☒ Yes ☐ No

If Yes, include the number of pumping plants: 2
For each pumping plant, list:

	Plant #1	Plant #2
The number of pumps	2	3
The ponding storage capacity	200 ac-ft	n/a
The maximum pumping rate	77 cfs	150 cfs
The maximum pumping head	24 feet	24 feet
The pumping starting elevation	5.1	
The pumping stopping elevation	2	
Is the discharge facility protected?	Yes	Yes
Is there a flood warning plan?	No	No
How much time is available between warning and flooding?		

Will the operation be automatic? ☒ Yes ☐ No

If the pumps are electric, are there backup power sources? ☒ Yes ☐ No

(Reference: USACE EM-1110-2-3101, 3102, 3103, 3104, and 3105)

Include a copy of supporting documentation of data and analysis. Provide a map showing the flooded area and maximum ponding elevations for all interior watersheds that result in flooding.

9. Other Design Criteria

a. The following items have been addressed as stated:

Liquefaction ☐ is ☒ is not a problem
Hydrocompaction ☐ is ☒ is not a problem
Heave differential movement due to soils of high shrink/swell ☐ is ☒ is not a problem

b. For each of these problems, state the basic facts and corrective action taken:

Attach supporting documentation

c. If the levee/floodwall is new or enlarged, will the structure adversely impact flood levels and/or flow velocities floodside of the structure?
☐ Yes ☐ No

Attach supporting documentation

d. Sediment Transport Considerations:

Was sediment transport considered? ☐ Yes ☒ No If Yes, then fill out Section F (Sediment Transport).
If No, then attach your explanation for why sediment transport was not considered.

E. LEVEE/FLOODWALL (CONTINUED)

10. Operational Plan And Criteria

    a. Are the planned/installed works in full compliance with Part 65.10 of the NFIP Regulations? ☒ Yes ☐ No

    b. Does the operation plan incorporate all the provisions for closure devices as required in Paragraph 65.10(c)(1) of the NFIP regulations?
    ☒ Yes ☐ No

    c. Does the operation plan incorporate all the provisions for interior drainage as required in Paragraph 65.10(c)(2) of the NFIP regulations?
    ☒ Yes ☐ No

    If the answer is No to any of the above, please attach supporting documentation.

11. Maintenance Plan

    a. Are the planned/installed works in full compliance with Part 65.10 of the NFIP Regulations? ☒ Yes ☐ No
    If No, please attach supporting documentation.

12. Operations and Maintenance Plan

    Please attach a copy of the formal Operations and Maintenance Plan for the levee/floodwall.

F. SEDIMENT TRANSPORT

Flooding Source:

Name of Structure:

If there is any indication from historical records that sediment transport (including scour and deposition) can affect the Base Flood Elevation (BFE); and/or based on the stream morphology, vegetative cover, development of the watershed and bank conditions, there is a potential for debris and sediment transport (including scour and deposition) to affect the BFEs, then provide the following information along with the supporting documentation:

Sediment load associated with the base flood discharge: Volume acre-feet

Debris load associated with the base flood discharge: Volume acre-feet

Sediment transport rate (percent concentration by volume)

Method used to estimate sediment transport:

Most sediment transport formulas are intended for a range of hydraulic conditions and sediment sizes; attach a detailed explanation for using the selected method.

Method used to estimate scour and/or deposition:

Method used to revise hydraulic or hydrologic analysis (model) to account for sediment transport:
Please note that bulked flows are used to evaluate the performance of a structure during the base flood; however, FEMA does not map BFEs based on bulked flows.

If a sediment analysis has not been performed, an explanation as to why sediment transport (including scour and deposition) will not affect the BFEs or structures must be provided.

TAB 2

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations tables in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations tables should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 10N. The **horizontal datum** was NAD 83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from U.S. Geological Survey Digital Orthophoto Quadrangles produced at a scale of 1:12,000 from photography dated 1989 or later.

This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

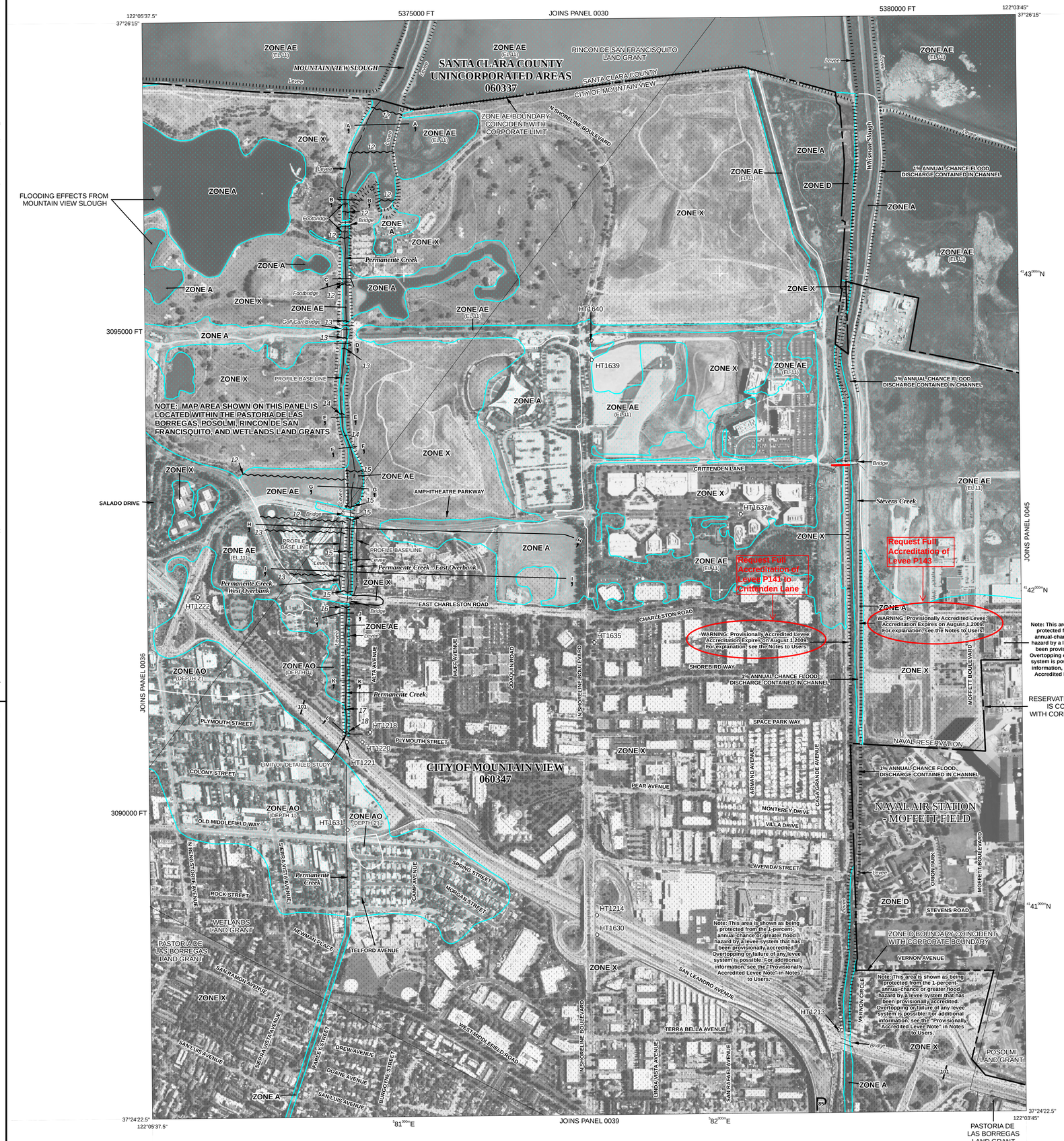
Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study report, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and its website at http://msc.fema.gov.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov.

Provisionally Accredited Levee Notes to Users: Check with your local community to obtain more information, such as the estimated level of protection provided (which may exceed the 1-percent-annual-chance level) and Emergency Action Plan, on the levee system(s) shown as providing protection for areas on this panel. To maintain accreditation, the levee owner or community is required to submit the data and documentation necessary to comply with Section 65.10 of the NFIP regulations by August 1, 2009. If the community or owner does not provide the necessary data and documentation or if the data and documentation provided indicate the levee system does not comply with Section 65.10 requirements, FEMA will revise the flood hazard and risk information for this area to reflect de-accreditation of the levee system. To mitigate flood risk in residual risk areas, property owners and residents are encouraged to consider flood insurance and floodproofing or other protective measures. For more information on flood insurance, interested parties should visit the FEMA Website at http://www.fema.gov/business/nfip/index.shtm.



LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary

0.2% annual chance floodplain boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

W——W S- - - - - -S	Cross section line Transect line
87°07'45", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
$^{24}76^{000m}$N	1000-meter Universal Transverse Mercator grid values, zone 10N
600000 FT	5000-foot grid ticks: California State Plane coordinate system, zone III (FIPSZONE 0403), Lambert Conformal Conic projection
DX5510 [	Bench mark (see explanation in Notes to Users section of this FIRM panel)
● M1.5	River Mile

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0037H

FIRM

FLOOD INSURANCE RATE MAP

SANTA CLARA COUNTY, CALIFORNIA
AND INCORPORATED AREAS

PANEL 37 OF 830

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
MOUNTAIN VIEW, CITY OF	060347	0037	H
SANTA CLARA COUNTY	060337	0037	H

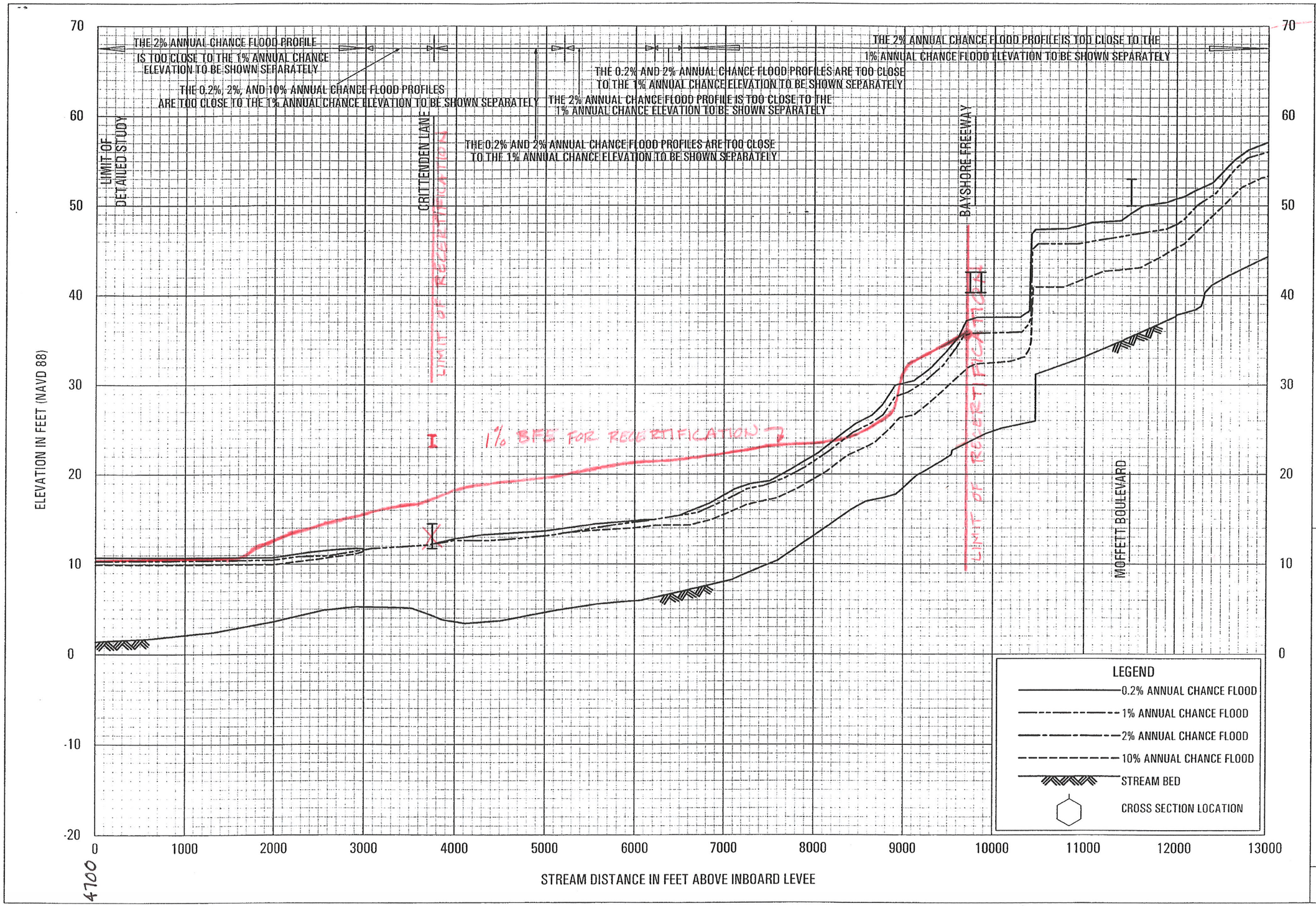
REVISED PRELIMINARY
JUNE 27, 2008

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06085C0037H

EFFECTIVE DATE

Federal Emergency Management Agency



RS 4700

FLOOD PROFILES

STEVENS CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

SANTA CLARA COUNTY, CA

AND INCORPORATED AREAS

TAB 3

US Army Corps of Engineers, SF District
Stevens Creek, San Tomas Aquino Creek, Guadalupe Slough
Survey Report

W.O. 6654.04
July, 2007

Prepared by:

BESTOR ENGINEERS, INC.
CIVIL ENGINEERING • SURVEYING • LAND PLANNING
9701 BLUE LARKSPUR LANE, MONTEREY, CA 93940
(831) 373-2941 • SALINAS (831) 424-7681 • FAX (831) 649-4118

I Introduction

II Horizontal and Vertical Control and Coordinate System

A Table of fixed control points

B Table of newly established control points

III Job Summary

A Control Survey

B GPS / Terrestrial Network Adjustment

C Topographic Surveying

D Data Reduction & Drafting

I. Introduction

This report summarizes a survey performed by Bestor Engineers, Inc. and Sea Surveyor, Inc. in March through April of 2007. Hydrographic and ground-based channel surveys were performed of 3 local tributaries to the San Francisco Bay in Santa Clara County, California, including Stevens Creek the San Francisco Bay to US Highway 101, San Tomas Aquino Creek from it's confluence with the Guadalupe Slough to US Highway 101, and the Guadalupe Slough from it's confluence with San Tomas Aquino Creek to the Sunnyvale East Channel.

II. Horizontal and Vertical Control and Coordinate System / Vertical Datum

The coordinate system for this project is the California Coordinate System, North American Datum of 1983 (NAD83), Zone 3. The project was adjusted to the 2004.00 epoch. Elevations are based on the North American Vertical Datum of 1988 (NAVD88). In establishing new control stations, a high resolution geoid model (GEOID03) was used to determine accurate orthometric height differences.

A. Table of fixed control points.

The following coordinates, published by the National Geodetic Survey (NGS) were held as primary control for the project:

Fixed Control Points (NAD83 CCS Zone 3, US Feet, NAVD88) (ADJUSTED TO 2004.00 EPOCH)				
Point	Northing	Easting	Elevation	Point Name
1998	1981335.30	6115993.90	4.20	ARC 34 (DG6881)
1999	1972515.53	6115440.19	36.10	LOCKHEED (DG6887)

Coordinates shown here have been adjusted to the 2004.00 epoch, and therefore differ slightly from the NGS published values.

The coordinates listed were recovered by Bestor Engineers and occupied with GPS as part of our control network. These coordinates (converted to 2004.00 epoch) were held fixed horizontally and vertically in our GPS network adjustment.

B. Table of Newly Established Control Points:

The following coordinates were established by through a combination of "faststatic" GPS methodology and conventional traversing. Points numbered 1900 through 1924 are located along the Stevens Creek Channel. 1946 through 1949 are located along the Guadalupe Slough, and 1950 through 1984 are along San Tomas Aquino Creek.

Monuments described below as "5/8" RBR & CAP" are 5/8" Rebar capped with a 2" diameter aluminum cap stamped "CORPS OF ENGINEERS – SAN FRANCISCO – SURVEY MARK." Monuments described as "BEMT" are "Mag Nail" brand nails with 1-14" brass washers stamped "BESTOR ENGINEERS." "Monuments described as "BEST" are the same brass washers, set with a 60D spike. Monuments described "1/2" RBR / PP" are ½" rebar with plastic caps stamped "BESTOR CONTROL"

Established Control Points (NAD83 CCS Zone 3 - 2004.00, US Feet, NAVD88)				
Point	Northing	Easting	Elevation	Description
1900	1988480.581	6107850.234	11.508	5/8 RBR & CAP
1901	1987753.09	6107094.235	11.131	5/8 RBR & CAP
1902	1986937.14	6106438.14	11.64	5/8 RBR & CAP
1903	1985885.26	6106482.96	10.93	5/8 RBR & CAP
1904	1984823.18	6106552.63	10.63	5/8 RBR & CAP
1905	1983761.66	6106530.06	12.45	5/8 RBR & CAP
1906	1982644.28	6106378.27	16.75	5/8 RBR & CAP
1907	1981659.45	6106299.82	19.23	5/8 RBR & CAP
1908	1980845.13	6106280.64	22.17	5/8 RBR & CAP
1909	1979769.39	6106283.41	23.43	5/8 RBR & CAP
1910	1978707.59	6106256.36	25.01	5/8 RBR & CAP
1911	1977617.11	6106207.72	18.95	5/8 RBR & CAP
1912	1976445.93	6106119.45	26.83	5/8 RBR & CAP
1913	1975908.93	6106100.67	33.63	5/8 RBR & CAP
1914	1975075.74	6106016.70	38.36	5/8 RBR & CAP
1915	1975384.05	6105902.85	38.14	5/8 RBR & CAP
1916	1975841.25	6105983.82	35.82	5/8 RBR & CAP
1917	1976337.62	6105963.71	28.15	5/8 RBR & CAP
1918	1976796.26	6106043.48	27.09	5/8 RBR & CAP
1919	1977861.92	6106075.54	25.78	5/8 RBR & CAP
1920	1978912.56	6106095.96	24.38	5/8 RBR & CAP
1921	1980020.98	6106111.31	22.88	5/8 RBR & CAP
1922	1975001.34	6105960.68	27.08	BEMT
1923	1974738.16	6105945.65	32.17	MAG NAIL
1924	1974805.78	6106009.09	40.59	BEST
1946	1977883.92	6127484.92	13.11	5/8 RBR & CAP
1947	1977764.98	6128155.36	13.04	5/8 RBR & CAP
1948	1977768.16	6128940.85	13.03	5/8 RBR & CAP
1949	1977741.90	6129607.12	14.31	5/8 RBR & CAP
1950	1977794.88	6130087.12	12.16	5/8 RBR & CAP
1951	1977893.49	6130951.22	12.59	5/8 RBR & CAP
1952	1977879.92	6131573.79	12.29	5/8 RBR & CAP
1953	1977171.09	6131706.37	15.54	5/8 RBR & CAP
1954	1976609.23	6131808.89	13.85	5/8 RBR & CAP
1955	1975764.27	6131947.56	19.33	5/8 RBR & CAP
1956	1974726.93	6132172.50	20.32	5/8 RBR & CAP
1957	1974088.66	6132975.29	21.51	5/8 RBR & CAP
1958	1973839.51	6133318.80	21.91	5/8 RBR & CAP
1959	1973215.32	6133725.33	22.81	5/8 RBR & CAP
1960	1972441.91	6134203.13	23.80	5/8 RBR & CAP
1961	1971984.34	6134625.66	27.07	5/8 RBR & CAP
1962	1971067.81	6134876.50	25.61	5/8 RBR & CAP
1963	1970058.13	6135235.65	26.52	5/8 RBR & CAP
1964	1969033.51	6135323.30	26.88	5/8 RBR & CAP
1965	1968261.98	6135181.23	27.94	5/8 RBR & CAP
1966	1967602.81	6135097.23	29.05	5/8 RBR & CAP
1967	1966472.53	6134878.76	35.24	5/8 RBR & CAP
1968	1965635.02	6135047.26	32.24	5/8 RBR & CAP
1969	1967950.80	6135128.25	28.99	1/2" RBR / PP
1970	1971824.94	6134663.35	24.97	1/2" RBR / PP
1971	1965725.36	6135012.43	15.08	CUT X
1972	1965001.41	6134924.72	36.47	1/2" RBR / PP
1973	1965310.17	6134924.01	34.72	1/2" RBR / PP

1974	1976831.48	6131777.80	9.87	BEMT
1975	1977862.58	6130051.24	17.33	BEMT
1976	1978289.09	6130796.22	50.05	1/2" RBR / PP
1977	1978097.82	6131979.72	55.64	1/2" RBR / PP
1978	1976977.02	6131712.72	20.99	BEST
1979	1974648.68	6132395.02	20.61	1/2" RPR / PP
1980	1975410.91	6132032.80	12.04	1/2" RPR / PP
1981	1975212.27	6132073.30	15.73	BEMT
1982	1976725.24	6131796.77	10.12	60D SPIKE
1983	1976925.41	6131759.78	9.63	MAG NAIL
1984	1977008.00	6131744.21	9.73	MAG NAIL

III. Job Summary

This project used a combination of GPS and conventional survey techniques, together with a multi-beam hydrographic survey conducted by Sea Surveyor Inc.

A. Control Survey:

22 new control points were set at Stevens Creek, and 23 new points were set at San Tomas Aquino Creek / Guadalupe Slough. Control points were monumented with 5/8" rebar with 2" aluminum caps stamped "Corps of Engineers - San Francisco - Survey Mark." Six control points at each creek (12 total) were surveyed using Trimble “Faststatic” survey techniques. Coordinates and elevations for the remainder of the points were determined through traversing between GPS points and performing a least-squares adjustment, holding the GPS determined coordinates.

Equipment used included Trimble dual frequency GPS receivers (models 4000ssi, 4700 & 5700) and Leica TCM1100 total stations. Conventional survey data was collected using TDS Ranger data collectors running TDS Survey Pro software.

The GPS survey included ties to both monuments specified in the scope of work, DG6881 ("ARC 34") and DG6887 ("Lockheed"). Coordinates for these points were converted from their published epoch (2002.75) to the specified project epoch of 2004.00 using the NGS' HTDP utility. The resulting 2004.00 coordinates were held fixed in the GPS network adjustment. GEOID03 was used to calculate orthometric heights.

As requested, we included in our survey a SCVWD control point near the mouth of Stevens Creek. We recovered a rebar with a large yellow plastic "Supportek" cap with a scribed "X". Our established NAD83 CCS zone III coordinate (2004.00 epoch) / NAVD 88 elevation for this point is as follows:

N: 1988527.62' E: 6107928.00' El: 12.16'

This differs by about 14' horizontally and 12' vertically from the UTM coordinate that was provided to us for that point, when converted to state plane.

Our control survey also included several other SCVWD benchmarks that our crews came across in the course of the survey.

GPS baselines were processed and the GPS network was adjusted using Trimble Geomatics Office, version 1.61.

B. GPS / Terrestrial Network Adjustment

Two separate least squares network adjustment was performed on GPS observations and conventional traverses using Trimble Geomatics Office ver. 1.6.

The GPS survey was adjusted holding fixed the two primary control points ("ARC 34" and "LOCKHEED") This adjustment established 12 new control points dispersed along the lengths of the channels.

The control network was densified by traversing between the GPS control points, providing intervisible control along the lengths of both channels. A separate adjustment was performed of the traverse data, holding fixed the previously established GPS control points. Adjusted closures were better than 1:5000.

GPS derived elevations for new control points were established by applying a high resolution geoid model (GEOID03) to the measured ellipsoid height differences between fixed control points to newly established stations.

C. Topographic Surveying:

The ground survey was conducted differently for the upstream and downstream portions of the channels. In the downstream areas where the creek bed was surveyed hydrographically, a cross sectional survey was performed. A 3-person survey crew was used, in order to have a rod person on either side of the channel, as the channels were generally impassible on foot in these areas. Pre-calculated points at 200' intervals were staked out on either side of the channels to define the cross-sections, and a full cross section was measured at each of these stations.

In the areas further upstream, a conventional topographic survey was performed. Our crew surveyed feature lines and measured points at intervals no greater than 200', in addition to grade breaks, channel bends, etc.

Bridges were surveyed separately in detail. As descriptions for measurements taken on bridges are generally more lengthy and detailed than for typical topography, descriptions for these measurements were recorded on paper field notes rather than electronically.

A multi-beam hydrographic survey was conducted by Sea Surveyor Inc (SSI) in conjunction with the ground based topographic survey. Coordinates were provided to SSI for points defining the 200' cross-sections to be surveyed. In additions, BE coordinated with SSI to establish benchmark elevations at each end of their surveys to reference tide measurements.

D. Data Reduction & Drafting

Survey data was downloaded and adjusted using Trimble Geomatics Office software, and adjusted coordinates were imported into AutoCAD Land Desktop 2007 for drafting and surface creation. The following point number ranges were used for survey points:

1900-1924: Control – Stevens Creek

1946-1972: Control – San Tomas Aquino Creek

2000(2885)-4853: Topo – Stevens Creek

6000-6528: Structures – Stevens Creek

12000-15400: Topo – San Tomas Aquino Creek

16000-18684: Structures – San Tomas Aquino Creek

A horizontal alignment was defined for the channels for Stevens Creek and San Tomas Aquino Creek, based on high resolution USGS aerial imagery. An existing alignment was used for the Guadalupe Slough, provided by the USACE.

BE CAD staff reduced the survey data, connected feature lines and grade breaks, and generated a 3D surface for each channel. Cross sections were then sampled from the surface at 200' intervals based on the horizontal alignments. In addition, cross sections were sampled at each bridge face, and at stations 50' upstream of any upstream bridge faces, and 50' downstream of any downstream bridge faces. The measurements along the edges of the bridges were used to define the direction of the cross sections for the bridge faces which were generally not perpendicular to the alignment of the channel.

Hydrographic Survey data was imported into AutoCAD by means of a point coordinate listing provided by SSI. This data was incorporated into the surfaces created for each channel.

Contours were generated to display the surface. Physical features that were located as part of this survey were drafted and labeled at a scale of 1" = 50'. CAD drawing that BE delivered also included TIN lines, survey points, and cross section sample lines on frozen layers.

Most bridge measurements were excluded from the surfaces that were created for the channels. Bridge information was manually added to the cross sections at bridge faces. Separate planimetric CAD drawings were created showing only the bridges along each channel. These were annotated at 1"=20', to be included as detail sheets in the plan set. The bridges proved too detailed to properly annotate at 1"=50."

Other Separate CAD drawings that were created include a drawing depicting each horizontal alignment, a control drawing, and separate drawings showing the cross sections of each channel.

Metadata was generated using ESRI ArcCatalog software.

Santa Clara County Contours

Data format: LAS, ASCII, ESRI geodatabase, Microstation V8, AutoCAD 2004

Coordinate system: State Plane Coordinate System

Theme keywords: LiDAR, DEM, DTM, ESRI personal geodatabase, DGN (V8), AutoCAD 2004

FGDC and ESRI Metadata:

- Identification Information
- Data Quality Information
- Spatial Data Organization Information
- Spatial Reference Information
- Distribution Information
- Metadata Reference Information

Metadata elements shown with blue text are defined in the Federal Geographic Data Committee's (FGDC) *Content Standard for Digital Geospatial Metadata (CSDGM)*. Elements shown with green text are defined in the *ESRI Profile of the CSDGM.* Elements shown with a green asterisk (*) will be automatically updated by ArcCatalog. ArcCatalog adds hints indicating which FGDC elements are mandatory; these are shown with gray text.

Identification Information:

Citation:

Citation information:

Originators: Optimal Geomatics, Inc

Title:

Santa Clara County Contours

Edition: 1.0

Geospatial data presentation form: LiDAR ASCII, ESRI personal geodatabase, DGN (V8) and AutoCAD (2004)

Publication information:

Publication place: Santa Clara County, California

Publisher: Santa Clara County, California

Description:

Abstract:

LAS format files, raw LiDAR data in its native format, classified bare-earth LiDAR DEM and photogrammetrically derived breaklines generated from LiDAR Intensity stereo-pairs. Breakline, Top of Bank, and contour files in ESRI personal geodatabase format, Microstation V8 .dgn format, and AutoCAD 2004 formats for the San Jose Phase 3 project of Santa Clara County, Ca.

Purpose:

The purpose of the bare-earth LiDAR Point and Breakline data is to provide ground surface data and one-foot (Valley Area) and five-foot (Mountain Areas) contour generation, and the delineation of watercourse (Top of Bank).

Supplemental information:
Breaklines were derived through photogrammetric techniques utilizing LiDAR intensity stereo-pairs.

Language of dataset: English (U.S.)

Time period of content:
Time period information:
Range of dates/times:
Beginning date: 06 April 2006
Ending date: 01 May 2006

Currentness reference:
ground condition

Status:
Progress: In work
Maintenance and update frequency: As needed

Spatial domain:
Bounding coordinates:
West bounding coordinate: 6051705.291546
East bounding coordinate: 6357983.392299
North bounding coordinate: 2011601.113402
South bounding coordinate: 1782807.312840

Keywords:
Theme:
Theme keywords: LiDAR, DEM, DTM, ESRI personal geodatabase, DGN (V8), AutoCAD 2004
Theme keyword thesaurus: None

Place:
Place keywords: United States, Santa Clara County, California, San Jose
Place keyword thesaurus: None

Temporal:

Access constraints: None
Use constraints:
The DTM data represents the results of data collection/processing for Santa Clara, California and indicates the existing general conditions. As such, they are only valid for their intended use, content, time and accuracy specifications. The user is responsible for the results of any application of data other than its intended purposes.

Point of contact:
Contact information:
Contact person primary:
Contact person: Stuart MacRitchie
Contact organization: Triathlon Ltd./MDA Geospatial Services

Contact address:
Address type: mailing address
Address:
13800 Commerce Parkway

City: Richmond
State or province: BC
Postal code: V6V 2J3
Country: Canada

Contact voice telephone: 604-233-5003
Contact facsimile telephone: 604-233-5005

Contact electronic mail address: smacritc@mda.ca

Hours of service: 8:00 am - 5:00 pm PST

Data set credit:

Optimal Geomatics, Inc
2227 Drake Avenue, SW.
Bldg. 14
Huntsville, AL 35805
Contact: Ronny Taylor
Phone: 256-882-7788
Fax: 256-882-7774
Contract No. RV-11328

Security information:

Security classification system: None
Security classification: Unclassified

Native dataset format: LAS, ASCII, ESRI geodatabase, Microstation V8, AutoCAD 2004

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Data Quality Information:

Attribute accuracy:

Attribute accuracy report:

LiDAR DEMs to support 1' contours have a maximum RMSE of 9 centimeters, which is roughly equivalent to 0.6' accuracy with a 95% confidence. Field verification of the vertical accuracy of the LiDAR DEM was conducted to ensure that the 9-centimeter RMSE requirement was satisfied for all major vegetation categories that were predominate within the 1' contour area.

Quantitative attribute accuracy assessment:

Attribute accuracy value: NSSDA 95% Confidence: 0.6'

Attribute accuracy explanation:

The RMSE calculated from a sample of test points is not the RMSE of the DEM. The calculated value may be higher or it may be lower than that of the DEM. Confidence in the calculated value increases with the number of test points. If the errors (lack of accuracy) associated with the DEM are normally distributed and unbiased, the confidence in the calculated RMSE can be determined as a function of sample size. Similarly, the sample RMSE necessary to obtain 95-percent confidence that the DEM RMSE is less than 9 centimeters can also be determined as a function of sample size. Optimal Geomatics collected test points using RTK (Real-Time Kinematic) GPS techniques. Over one hundred and twenty points were collected in total

over various terrain classes. All RMSE calculations were performed on the bare-earth, orthometric surface.

Logical consistency report:

LiDAR was classified and stereo-pairs were generated from LiDAR intensity data which were used to collect breaklines and top of bank. A surface was generated from the bare earth LiDAR DTM and collected breakline data to produce 1', 5', 10' and 25' contours in pre-assigned areas designated by the client.

Completeness report:

Each strip was imported into a project using TerraScan (Terrasolid, Ltd.) and the project management tool GeoCue (GeoCue Corp.). By creating a project, the various flightlines are combined while breaking the dataset as a whole into manageable pieces. This process also converts the dataset from geographic coordinates to the State Plane Coordinate System (NAD83), California III. The ellipsoid height values were converted to NAVD88 orthometric values using Geoid03, provided by NGS. Individual lines were then checked against adjacent lines to ensure a cohesive dataset. The data from each line were then combined and a classification routine was then run to determine the initial surface model. This initial surface model was then reduced using Optimal Geomatics' proprietary methods to create the final bare-earth dataset. A Triangular Irregular Network (TIN) was generated using the final surface data. Contours were then created from the TIN. The bareearth data were then checked against the validation points across the project area. The results of these checks showed the DEM fitting the validation points well (see LiDAR DEM Quality Control Report for results). Stereo pairs were generated from the LiDAR intensity data using Geocue and LiDAR1CuePac (GeoCue Corp.). LiDARgrammetry was then utilized to collect breaklines where necessary along hydro features to support the contour generation. These breaklines were collected as a 3D element in the MicroStation (Bentley Systems, Inc.) environment utilizing ISSD (Z/I Imaging). The breaklines, top of bank (TOB), contour files were delivered in MicroStation v8, AutoCAD 2004 and ESRI Personal GeoDatabase formats. The LiDAR point data were delivered in LAS and ASCII formats. LiDAR orthos were delivered in TIF/TFW format.

Positional accuracy:

Horizontal positional accuracy:

Horizontal positional accuracy report:

No specific testing was done to determine horizontal accuracy of the DTM. Test results for vertical accuracy tend to show that the 0.75m (2.46 US survey feet) RMSE horizontal accuracy tolerance determined by system studies and other methods was met or exceeded.

Quantitative horizontal positional accuracy assessment:

Horizontal positional accuracy value: 0.75 m (2.46 US survey feet)

Horizontal positional accuracy explanation:

Expected horizontal accuracy of elevation products as determined from system studies
and other methods is 1/2000th of the flight height, which in the instance of this particular
project was 1500m (4921.2 US survey feet) AGL, giving a horizontal tolerance of less
than 0.75m (2.46 US survey feet).

Vertical positional accuracy:

Vertical positional accuracy report:

Tested to meet 0.6 ft vertical accuracy at 95 percent confidence level.

Quantitative vertical positional accuracy assessment:
Vertical positional accuracy value: NSSDA 95% Confidence: 0.21' in open terrain
Vertical positional accuracy explanation:
Tested 0.21' in open terrain at ninety-five percent confidence level using RMSE(z) x 1.9600.

Lineage:
Source information:
Source citation:
Citation information:
Originators: San Jose, California

Title:
San Jose Phase 3, Santa Clara County, California LiDAR Survey

Publication date: 2006
Publication time: Unknown
Edition: 1.0
Geospatial data presentation form: LiDAR ASCII, ESRI personal geodatabase, DGN (V8), and AutoCAD (2004)

Publication information:
Publication place: San Jose, Santa Clara County, California
Publisher: San Jose, Santa Clara County, California

Type of source media: FireWire & DVD (3-sets)
Source contribution:
LiDAR DEM
LiDARGrammetry derived Breaklines & TOB Contours

Source time period of content:
Time period information:
Range of dates/times:
Beginning date: 06 April 2006
Ending date: 01 May 2006

Source currentness reference:
ground condition

Process step:
Process description:
Each strip was imported into a project using TerraScan (Terrasolid, Ltd.) and the project management tool GeoCue (GeoCue Corp.). By creating a project the various flightlines are combined while breaking the dataset as a whole into manageable pieces. This process also converts the dataset from geographic coordinates to the State Plane Coordinate System (NAD83), California III. The ellipsoid height values were converted to NAVD88 orthometric values using Geoid03, provided by NGS. Individual lines were then checked against adjacent lines to ensure a cohesive dataset. The data from each line were then combined and a classification routine was then run to determine the initial surface model. This initial surface model was then reduced using Optimal Geomatics' proprietary methods to create the final bare-earth dataset. A Triangular Irregular Network (TIN) was generated using the final surface data. Contours were then created from

the TIN. The bareearth data were then checked against the validation points across the project area. The results of these checks showed the DEM fitting the validation points well (see LiDAR DEM Quality Control Report for results). Stereo pairs were generated from the LiDAR intensity data using Geocue and LiDAR1CuePac (GeoCue Corp.). LiDARgrammetry was then utilized to collect breaklines where necessary along hydro features to support the contour generation. These breaklines were collected as a 3D element in the MicroStation (Bentley Systems, Inc.) environment utilizing ISSD (Z/I Imaging). The breaklines, top of bank (TOB), contour files were delivered in MicroStation v8, AutoCAD 2004 and ESRI formats. The LiDAR point data were delivered in LAS and ASCII formats. LiDAR orthos were delivered in TIF/TFW format.

Process date: Not complete

Source used citation abbreviation:
N/A
Source produced citation abbreviation:
N/A

Process contact:
Contact information:
Contact organization primary:
Contact person: Stuart MacRitchie
Contact organization: Triathlon, Ltd. / MDA Geospatial Services

Contact address:
Address type: mailing and physical address
Address:
13800 Commerce Parkway
Address:
MacDonald Dettwiler Bldg.
City: Richmond
State or province: BC
Postal code: V6V 2J3
Country: Canada

Contact voice telephone: 604-233-5003
Contact facsimile telephone: 604-233-5005

Contact electronic mail address: smacritc@mda.ca

Hours of service: 8:00 am - 5:00 pm PST

Back to Top

Spatial Data Organization Information:

Direct spatial Rreference method: Point & Vector

Point and vector object information:
ESRI terms description:

Feature description: LiDAR DEM

ESRI terms description:
Feature description: Breakline

ESRI terms description:
Feature description: Top of Bank

ESRI terms description:
Feature description: Contours

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Spatial Reference Information:

Horizontal coordinate system definition:
Coordinate system name:
Projected coordinate system name: California State Plane Coordinate Zone 3

Planar:
Grid coordinate system:
Grid coordinate system name: State Plane Coordinate System
State Plane Coordinate System:
SPCS zone identifier: 403
Lambert conformal conic:
Standard parallel: 37:04:00:00
Standard parallel: 38:26:00:00
Longitude of central meridian: -120:30:00
Latitude of projection origin: 36:30:00
False easting: 6561666.667
False northing: 1640416.667

Planar coordinate information:
Planar coordinate encoding method: coordinate pair
Planar distance units: survey feet

Geodetic model:
Horizontal datum name: North American Datum of 1983
Ellipsoid name: Clarke 1866
Semi-major axis: 6378403.701 m
Denominator of flattening ratio: 298.2572221008827

Vertical coordinate system definition:
Altitude system definition:
Altitude datum name: North American Vertical Datum of 1988
Altitude resolution: .001
Altitude distance rnits: feet
Altitude encoding method: Implicit coordinate

Depth system definition:
Depth datum name: Mean sea level
Depth resolution: .01
Depth distance units: feet
Depth encoding method: Implicit coordinate

Back to Top

Distribution Information:

Distributor:
Contact information:
Contact person primary:
Contact person: Stuart MacRitchie
Contact organization: Triathlon, Ltd. / MDA Geospatial Services

Contact address:
Address type: mailing address
Address:
13800 Commerce Parkway
City: Richmond
State or province: BC
Postal code: V6V 2J3
Country: Canada

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Contact facsimile telephone: 604-233-5005

Contact electronic mail address: smacritc@mda.ca

Hours of service: 8:00 am - 5:00 pm PST

Resource description: City, Government

Distribution liability:
The LiDAR data represents the results of data collection/processing for Santa Clara County, California and indicates the general conditions existing at the time of flight. As such, it is only valid for its intended use, content, time and accuracy specifications. The user is responsible for the results of any application of the data other than for its intended purpose.

Standard order process:
Digital form:
Digital transfer information:
Format name: ASCII
Format specification:
3D LiDAR
Format information content:
XYZI and LAS
File decompression technique: Uncompressed

Digital transfer option:
Online option:
Computer contact information:
Network address:
Network resource name: N/A

Digital form:

Digital transfer information:
Format name: DWG
Format version number: 2004
Format specification:
3D DWG
Format information content:
Index, Intermediate, Brkline and TOB

Digital form:
Digital transfer information:
Format name: DGN
Format version number: V8
Format specification:
3D DGN
Format information content:
Index, Intermediate, brkline, and TOB

Digital form:
Digital transfer information:
Format name: ESRI
Format version number: personal geodatabase
Format information content:
1 foot, 5 foot, 10 foot, 25 foot contours, breaklines and top of bank

Fees: N/A

Available time period:
Time period information:
Single date/time:
Calendar date: unknown

Back to Top

Metadata Reference Information:

Metadata date: 20060607

Metadata contact:
Contact information:
Contact organization primary:
Contact person: Stuart MacRitchie
Contact organization: Triathlon, Ltd. / MDA Geospatial Services

Contact address:
Address type: mailing and physical address
Address:
13800 Commerce Parkway
Address:
MacDonald Dettwiler Bldg.
City: Richmond
State or province: BC
Postal code: V6V 2J3
Country: Canada

Contact voice telephone: 604-233-5003
Contact facsimile telephone: 604-233-5005

Contact electronic mail address: smacritc@mda.ca

Hours of service: 8:00 am - 5:00 pm PST

Metadata standard name: FGDC Content Standards for Digital Geospatial Metadata
Metadata standard version: FGDC-STD-001-1998
Metadata time convention: local time

Metadata extensions:
Online linkage: http://www.esri.com/metadata/esriprof80.html
Profile name: ESRI Metadata Profile

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TAB 4

REFERENCE INFORMATION AND NOTES

1) Grid based on Calif. State Plane Coords. N.A.D. 83, Zone III, Ft.
2) Vertical Datum: N.A.V.D. 1988, Ft.
3) Tested 1.181 ft horizontal accuracy at 95% confidence level.
4) Tested 0.728 ft vertical accuracy at 95% confidence level.
5) Date of Photgraphy: 10-05-2000

REGISTERED PROFESSIONAL ENGINEER
CHARLES D. ANDERSON
No. 43776
Exp. 6-30-09
CIVIL
STATE OF CALIFORNIA

CERTIFICATION

THIS IS TO CERTIFY THAT THE DATA ON THIS WORK MAP IS ACCURATE AND THE FLOOD PLAIN ANALYSES HAVE BEEN COMPLETED IN ACCORDANCE WITH SOUND ENGINEERING PRACTICES, PER NFIP REGULATIONS,PART 65.2 (B).

CHARLES D. ANDERSON, SCHAAF & WHEELER CONSULTING CIVIL ENGINEERS
CALIFORNIA RCE NO. 43776 EXP. 6-30-09

LICENSED LAND SURVEYOR
STEVE G. CROY
No. 6672
Exp. 6-30-08
STATE OF CALIFORNIA

DATE	JULY 2008
DESIGN	
DRAWN	
CHECKED	

Santa Clara Valley Water District

STEVENS CREEK

Interior Drainage Study

VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

SCALE 1"=200'

SHEET 1 OF 3

REFERENCE INFORMATION AND NOTES
1) Grid based on Calif. State Plane Coords. N.A.D. 83, Zone III, Ft.
2) Vertical Datum: N.A.V.D. 1988, Ft.
3) Tested 1.181 ft horizontal accuracy at 95% confidence level.
4) Tested 0.728 ft vertical accuracy at 95% confidence level.
5) Date of Photgraphy: 10-05-2000

REGISTERED PROFESSIONAL ENGINEER
CHARLES D. ANDERSON
No. 43776
Exp. 6-30-09
CIVIL
STATE OF CALIFORNIA

CERTIFICATION

THIS IS TO CERTIFY THAT THE DATA ON THIS WORK MAP IS ACCURATE AND THE FLOOD PLAIN ANALYSES HAVE BEEN COMPLETED IN ACCORDANCE WITH SOUND ENGINEERING PRACTICES, PER NFIP REGULATIONS,PART 65.2 (B).

CHARLES D. ANDERSON, SCHAAF & WHEELER CONSULTING CIVIL ENGINEERS
CALIFORNIA RCE NO. 43776 EXP. 6-30-09

LICENSED LAND SURVEYOR
STEVE G. CHOY
No. 6672
Exp. 6-30-08
STATE OF CALIFORNIA

DATE	JULY 2008
DESIGN	
DRAWN	
CHECKED	

Santa Clara Valley Water District

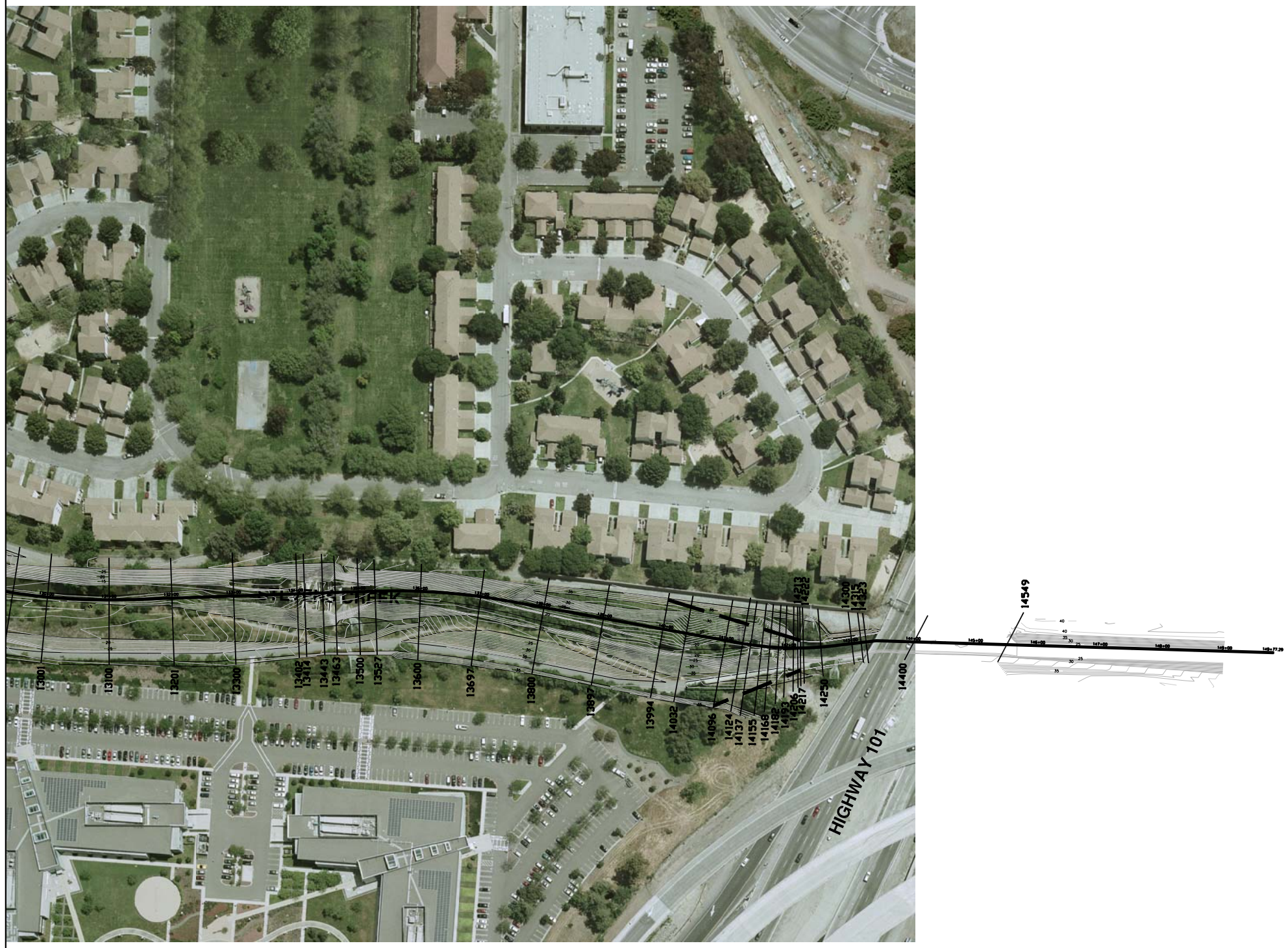
STEVENS CREEK

Interior Drainage Study

VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

SCALE 1"=200'

SHEET **2** OF 3



REFERENCE INFORMATION AND NOTES
1) Grid based on Calif. State Plane Coords. N.A.D. 83, Zone III, Ft.
2) Vertical Datum: N.A.V.D. 1988, Ft.
3) Tested 1.181 ft horizontal accuracy at 95% confidence level.
4) Tested 0.728 ft vertical accuracy at 95% confidence level.
5) Date of Photgraphy: 10-05-2000

REGISTERED PROFESSIONAL ENGINEER
CHARLES D. ANDERSON
No. 43776
Exp. 6-30-09
CIVIL
STATE OF CALIFORNIA

CERTIFICATION

THIS IS TO CERTIFY THAT THE DATA ON THIS WORK MAP IS ACCURATE AND THE FLOOD PLAIN ANALYSES HAVE BEEN COMPLETED IN ACCORDANCE WITH SOUND ENGINEERING PRACTICES, PER NFIP REGULATIONS,PART 65.2 (B).

CHARLES D. ANDERSON, SCHAAF & WHEELER CONSULTING CIVIL ENGINEERS CALIFORNIA RCE NO. 43776 EXP. 6-30-09

LICENSED LAND SURVEYOR
STEVE G. CHOY
No. 6672
Exp. 6-30-08
STATE OF CALIFORNIA

DATE	JULY 2008
DESIGN	
DRAWN	
CHECKED	

Santa Clara Valley Water District

STEVENS CREEK

Interior Drainage Study

VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

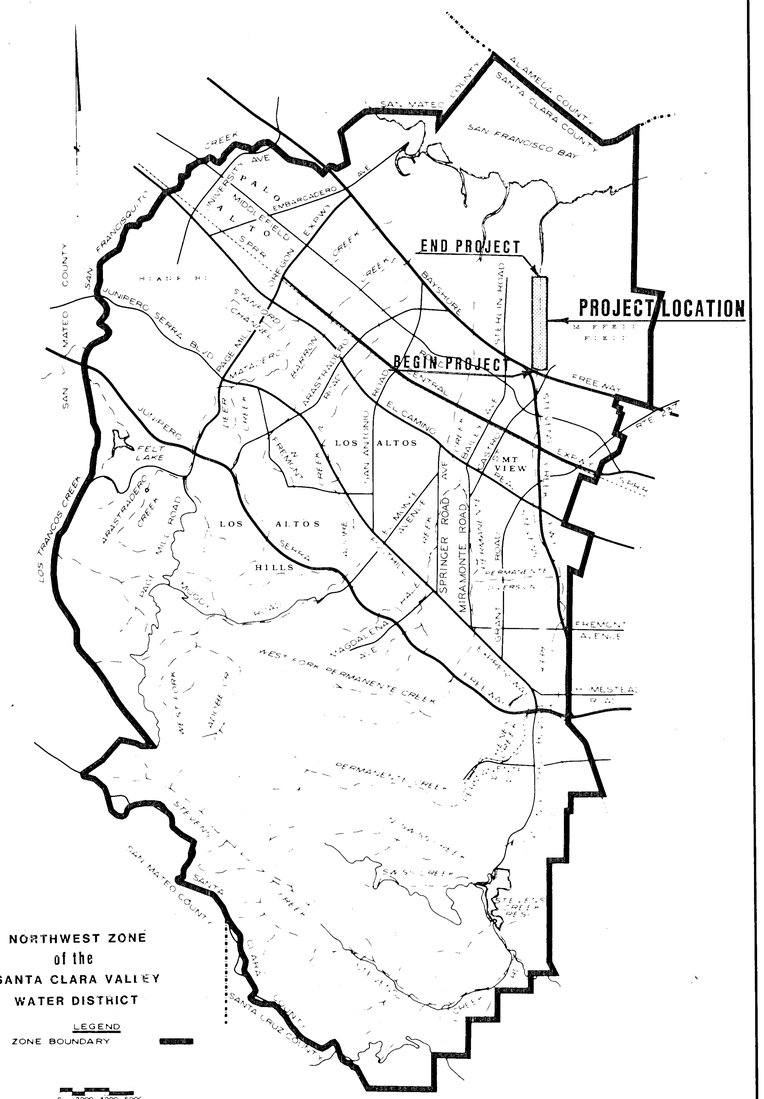
SCALE 1"=200'

SHEET **3** OF 3

STEVENS CREEK - CROSS-SECTION LOCATIONS
SHEET 1

STEVENS CREEK - CROSS-SECTION LOCATIONS
SHEET 2

TAB 5



MAP AND CONSTRUCTION PLAN

FOR

STEVENS CREEK

HWY 101 TO SHORELINE PARK

Santa Clara Valley Water District

NORTHWEST FLOOD CONTROL ZONE

PROJECT NO. 1029

INDEX

SHEET NO.	DESCRIPTION
1	MAP & TITLE PAGE.
2	LOCATION & INDEX MAP.
3	GENERAL NOTES, ABBREVIATIONS & LEGEND.
4-9	PLAN & PROFILE.
10-11	TYPICAL SECTIONS.
12-14	LAYOUT
15-24	DETAILS.
25-26	LOG OF SOIL BORINGS.
27-45	CROSS SECTIONS.

Dan Arroyo
2/22/83

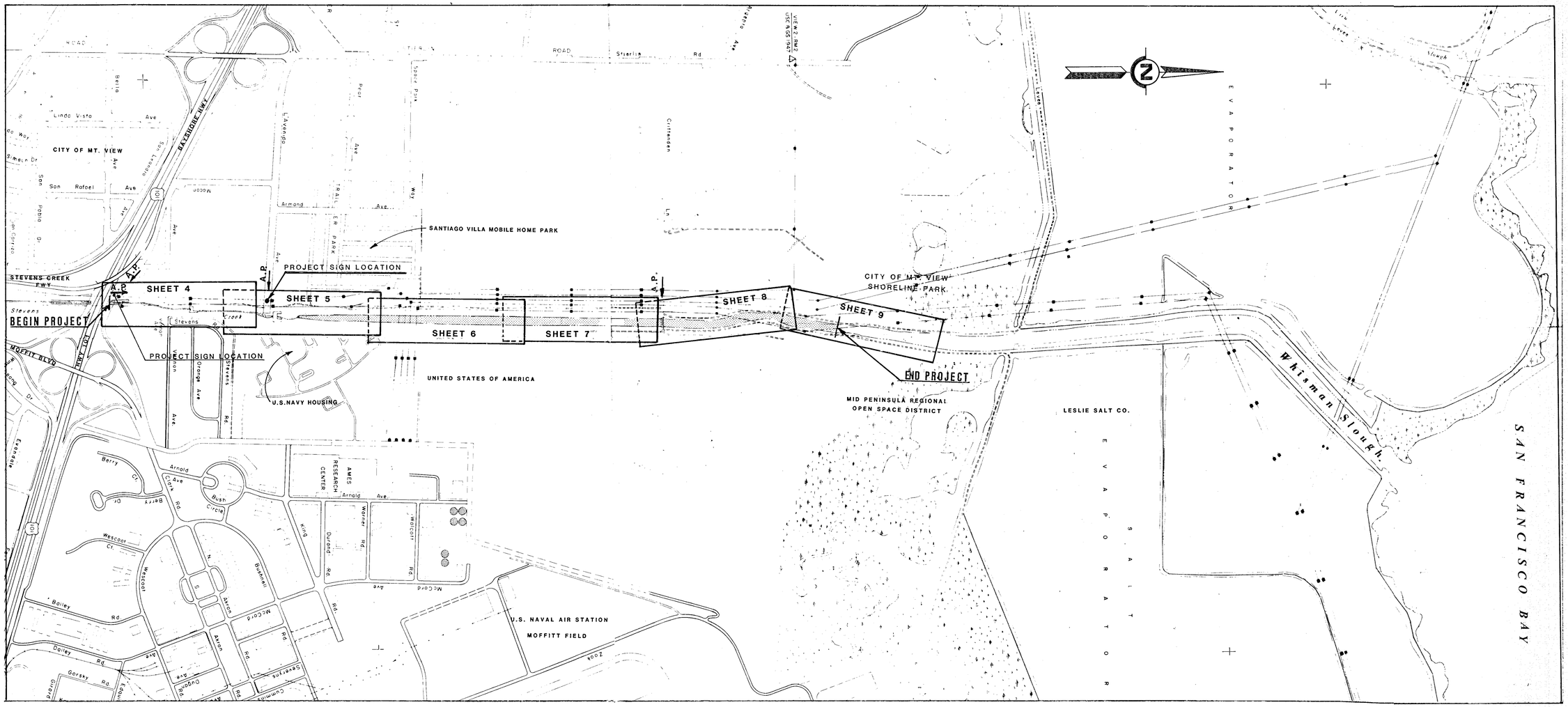
PROJECT APPROVAL:

FLOOD CONTROL MANAGER

DATE:

SANTA CLARA_CA Work Maps
SANTA CLARA_CA0574

11834



Dean Arroyo
3/23/83

SANTA CLARA_CA Work Maps
SANTA CLARA_CA0575

REV.	DESCRIPTION	DATE	APPR.	REFERENCE INFORMATION AND NOTES

DATE 3-1-5
DESIGN J.E. FOWLER
DRAWN S.A.S.
CHECKED J. Fandit

Santa Clara Valley Water District

PROJECT ENGINEER R.C.E. No. 19214
ENGINEERING APPROVAL
DIVISION ENGINEER R.C.E. No. 18759

STEVENS CREEK
HWY 101 TO SHORELINE PARK
LOCATION & INDEX MAP

SCALE 1" = 500'
SHEET 2 OF 45

11835

GENERAL NOTES

1. All existing facilities ,structures ,trees ,fences ,landscaping ,etc.,designated "Exist." or shown existing (dashed lines) are to remain . Only those specifically designated for removal as shown on the drawings, or as directed by the Engineer, shall be removed.
2. All references made to RIGHT or LEFT and all cross-sections shown on the plans are viewed looking **downstream.**
3. Electrical and television lines shown on the plans are overhead facilities, unless noted otherwise.
4. Locations and depths of existing underground utilities as shown on the plans are based on information from the the utility and are to be considered as approximate only.
5. Prior to performing any work in the vicinity of existing underground utilities, the contractor shall verify their locations and depths and take proper precautions to avoid any damage to them.
6. **All levee side slopes are 2:1 unless noted otherwise.**
7. **Limits of clearing and grubbing shall be confined to only the construction areas at the project site unless noted otherwise.**
8. **All stationing on the plans are right angles to the "P" Line unless noted otherwise.**

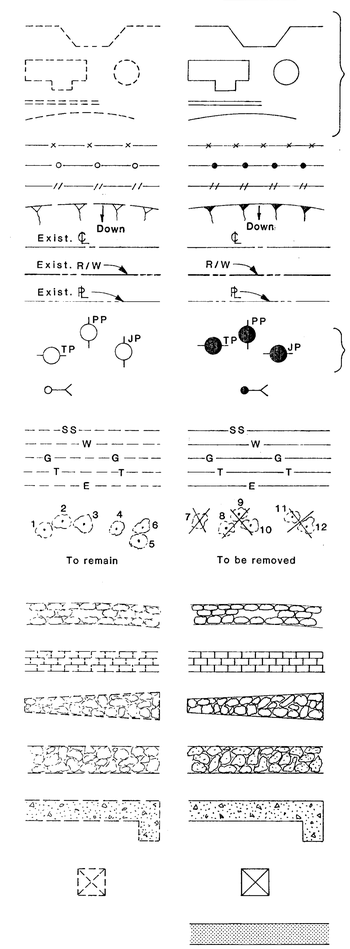
DESIGN NOTES

1. Design discharge (Q) is as designated on the plans. **7,340 CFS**
2. Mannings roughness coefficient (n) is as follows where applicable.
   - A. Earth channel = **.04 through .06**
   - B. Concrete channel = **.02**
   - C. Rock channel = **.04**
   - D. Gabion channel = **.03**
   - E. Sacked concrete = **.03**
   - F. Modified Flood Plain = **.06**
3. Unit Stresses for reinforced concrete are as follows:
   - A. Concrete fc' psi = **3,000**
   - B. Steel fs psi = **60,000**
4. Basis of Elevation:
   USC&GS Brass Disc E-111 Elev. 33.74' (updated 1976)
5. Basis of Bearings:
   The centerline of L'Avenida Avenue, shown as S87°00'00"E on that certain Record of Survey filed in Book 274 of Maps at Page 24, Santa Clara County Records, was taken as S86°43'40"E for the Basis of Bearings.

ABBREVIATIONS

AB	Anchor Bolt
ABM	Aggragate Base Material
AC	Asphalt Concrete
ACI	American Concrete Institute
ALIGN	Alignment (Aligned)
AMP	Ampere
APPROX	Approximate (Approximately)
AVRG	Average
BC	Begin Curve
BF	Both Faces
BM	Bench Mark
BRNG	Bearing
BR	Bridge
BW	Barbed Wire
C	Chords
CALTRANS	California Department of Transportation
CB	Catch Basin
CCP	Concrete Cylinder Pipe
CFM	Cubic Feet per Minute
CFS	Cubic Feet per Second
CIP	Cast Iron Pipe
CJ	Construction Joint
CLR	Clear (Clearance)
CL-6	Chain Link Fence (Number-Height)
CM	Centimeter
CMP	Corrugated Metal Pipe
CONC	Concrete
CONST	Construct (Construction)
CONT	Continuous (Control)
CWS	California Water Service
CY	Cubic Yards
CYL	Cylinder
DEG (°)	Degrees
DI	Drop Inlet
DIA	Diameter
DIP	Ductile Iron Pipe
DR	Drive
D/S	Downstream
DSDD	Double Swing Double Drive (Gate)
DWG	Drawing (Drawings)
DWN	Down
E	East Electric
EA	Each
EC	End Curve
EL	Elevation
ELECT	Electric (Electrical)
ENGR	Engineer (Enineering)
EP	Edge of Pavement
EXIST	Existing
EXPWY	Expressway
FD	Found
FF	Far Face
FG	Finish Grade
FH	Fire Hydrant
FT (')	Feet (Foot)
FTG	Footing
FWY	Freeway
G	Gas
GA	Guage (Gage)
GALV	Galvanize (Galvanized)
GAP	Guy Anchor and Pole
GB	Grade Break
GFI	Ground Fault Interrupter
GP	Guy Pole
GPM	Gallons per Minute
GPS	Gallons per Second
GR	Grade
GRND	Ground
GRP	Group
GTC	General Telephone Company
H	Height
HGL	Hydraulic Grade Line (Design)
H&T	Hub and Tack
HORIZ	Horizontal
HP	Horsepower
HWY	Highway
I	Irrigation
ID	Inside Diameter (Dimension)
IF	Inside Face
IN (")	Inch (Inches)
INV	Invert
IP	Iron Pipe
JP	Joint Pole
JT	Joint
JUNCT	Junction
k	Kilo (1,000)
km	Kilometer
kv	Kilovolt
kw	Kilowatt
L	Length
LN	Lane
LT	Left
m	Meter
MAINT	Maintenance
MAX	Maximum
MFP	Modified Flood Plain
MH	Manhole
MIN	Minimum
MON	Monument
N	North
N/A	Not Applicable Not Available
NE	Northeast
NE'LY	Northeasterly
NF	Near Face
NIC	Not In Contract
NTS	Not To Scale
NW	Northwest
NW'LY	Northwesterly
OC	On Center
OD	Outside Diameter (Dimension)
OF	Outside Face
OH	Overhead
OPNG	Opening
PB	Pull Box
PCC	Portland Cement Concrete Point of Compound Curve
PG&E	Pacific Gas and Electric
PI	Point of Intersection
POB	Point of Beginning
POT	Point on Tangent
PP	Power Pole
PRC	Point of Reverse Curve
PSI	Pounds per Square Inch
PSP	Polystyrene Pipe
PT	Point
PT&T	Pacific Telephone and Telegraph
PVC	Polyvinyl Chloride (Pipe)
PVMT	Pavement
Q	Design Discharge (cubic feet per second)
R	Radius
RCB	Reinforced Concrete Box
RCP	Reinforced Concrete Pipe
RD	Road
REBAR	Reinforcing Steel Bar (Deformed)
REINF	Reinforcement (Reinforcing)
REQ'D	Required
RT	Right
RTE	Route
RR	Railroad
R/W	Right of Way
S	South - Slope
SCHED	Schedule
SCVWD	Santa Clara Valley Water District
SD	Storm Drain
SE	Southeast
SEC (")	Seconds
SECT	Section
SE'LY	Southeasterly
SHT	Sheet
SJWW	San Jose Water Works
SPECS	Specifications
SPRR	Southern Pacific Railroad
SQ FT	Square Feet
SS	Sanitary Sewer
STA	Station
STD	Standard
STL	Steel
STRUCT	Structure
SW	Southwesterly
SY	Square Yards
SYM	Symmetrical
STC	**Stevens Creek Survey Point**
T	Tangent Telephone
TAN BRNG	Tangent Bearing
TBM	Temporary Bench Mark
TCA	Temporary Construction Area
TFC	Traffic
TOB	Top of Bank
TOC	Toe of Channel Top of Curb
TP	Telephone Pole Turning Point
TPT-1	Test Pit (Number = Designation/Location)
TS	Traffic Signal
TV	Television (Cable or Facility)
TW	Top of Wall
TYP	Typical
UB	Utility Box
UC	Utility Conduit
UG	Underground
U/S	Upstream
USC&GS	United States Coastal and Geodetic Survey
V	Volts
VCP	Vitrified Clay Pipe
VERT	Vertical
W	West Water
WD	Wood (Wooden)
WPRR	Western Pacific Railroad
WSP	Water Surface Profile
WV	Water Valve
WW	Wing Wall
WWF	Welded Wire Fabric
X-SECT	Cross Section
YD	Yard
Z	Zone

LEGEND



4 / 10	4 Indicates Detail Number 10 Indicates Sheet Number on Which Detail Appears
A / 10	A Indicates Section 10 Indicates Sheet Number on Which Section Appears
	Angle Point
	Curve,Central Angle
	Survey Monument or Horizontal Control Point
	Bench Mark
	Panel Point (Aerial)
	Water Surface (Profile)
3	Drilled Soil Test Sample (Number = Test Log Number)
5	Surface Soil Test Sample (Number = Test Log Number)
AP	Access Point From Public Street,Highway or Freeway
ER	Exist. Ramp to Channel Bottom
	Valve (Designate With Abbreviation)
TP-1	Test Pit (Nr. = Location/Designation)
	Angle
	And
@	At
℄	Centerline (Control Line)
FL	Flow Line
ML	Monument Line
%	Percent
PL	Property Line
Ø	Round
#	Number
125	Numerical Point Designation
	Monument Set as Noted
	3/4" I.P. Set
	Found Iron Pipe as Noted
	Found St'd. City Monument
1	Construction Notation

RECORD DRAWING
PROJECT SUPERVISOR
BY Dean Arroyo
DATE 2/22/83

SANTA CLARA_CA Work Maps
SANTA CLARA_CA0576

NO.	DESCRIPTION	DATE	APPR.	REFERENCE INFORMATION AND NOTES

DATE 3-1-82
DESIGN Lei/Fowler
DRAWN S.W.
CHECKED J.Pandit

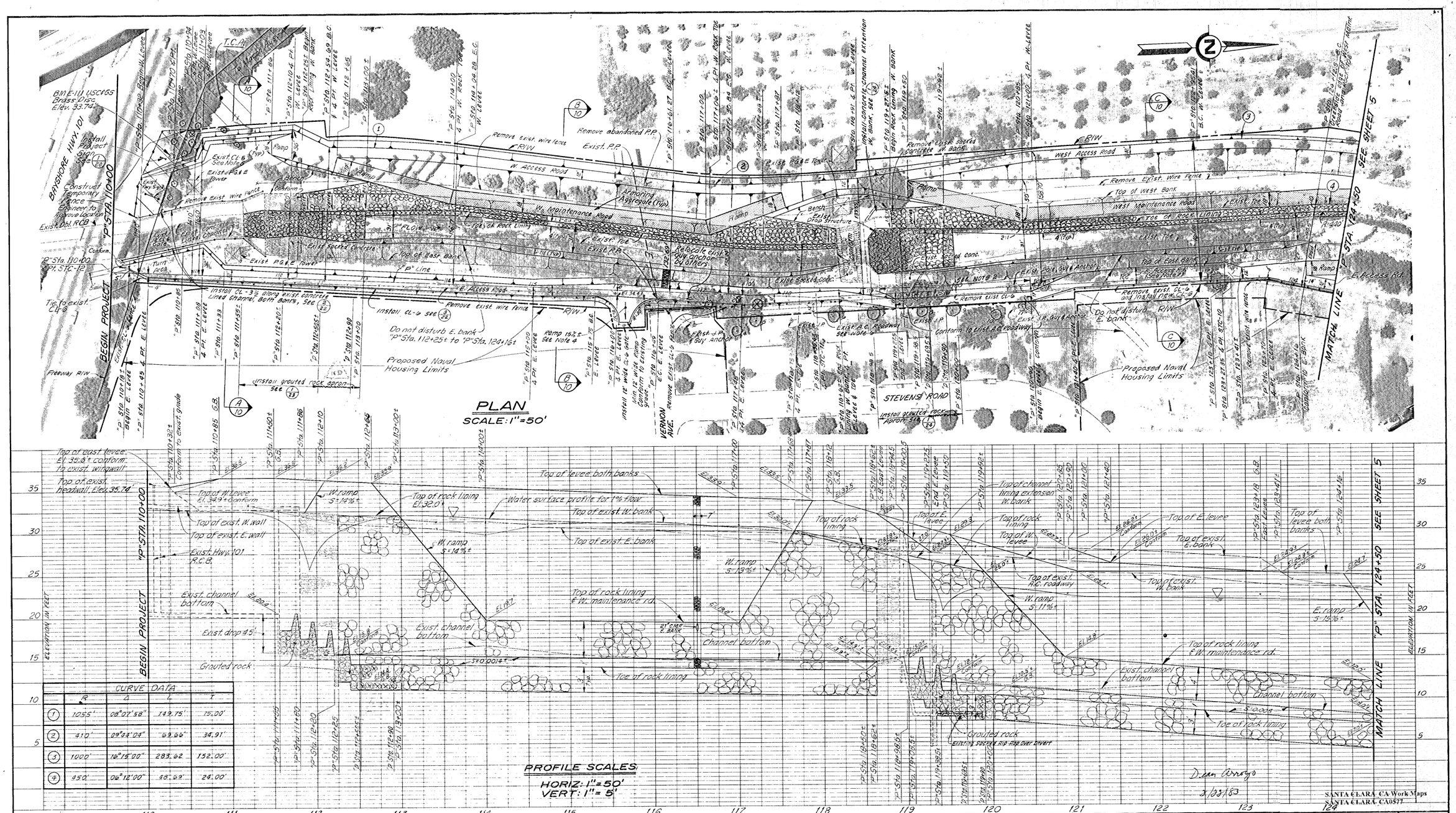
Santa Clara Valley Water District

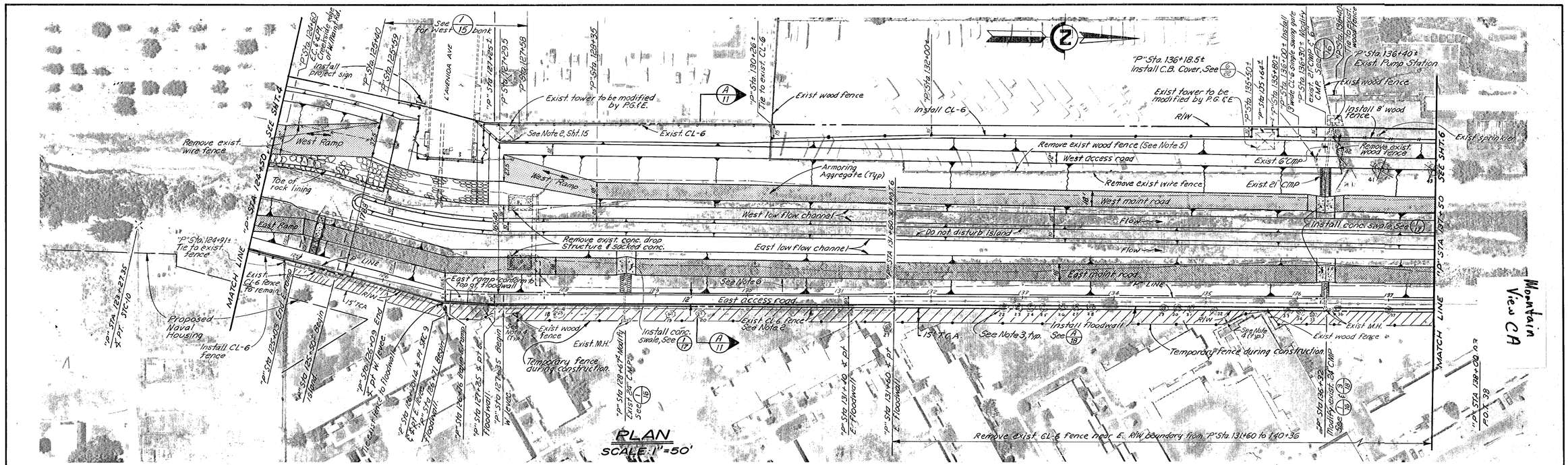
ENGINEERING CERTIFICATION — R.C.E. No. 19214
ENGINEERING APPROVAL — DIVISION ENGINEER — R.C.E. No. 18759

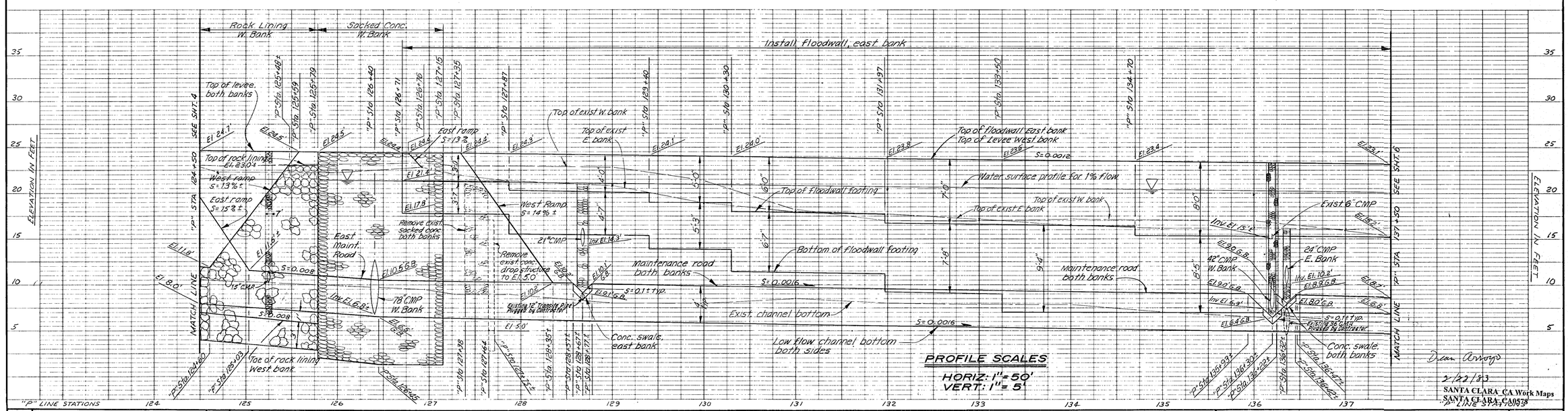
STEVENS CREEK
HWY 101 TO SHORELINE PARK
GENERAL NOTES, ABBREVIATIONS & LEGEND

SCALE NONE
SHEET 3 OF 45

11836


PLAN
SCALE: 1" = 50'
BEGIN PROJECT "P" STA. 110+00
MATCH LINE "P" STA. 124+50
SEE SHEET 5
BAYSHORE HWY. 101
STEVENS ROAD
VERNON AVE.
Proposed Naval Housing Limits
W. Access Road
West Access Road
West Maintenance Road
E. Access Rd.
Top of West Bank
Top of East Bank
Remove Exist. Wire Fence
Remove abandoned P.P.
Exist. P.P.
Armoring Aggregate (Typ.)
Install grouted rock apron see 1/23
Install CL-3½ along exist. concrete lined channel, Both Banks, See 2/22
Install CL-6 see 3/22
Remove exist. CL-6 and install new CL-6
Do not disturb E. bank "P" Sta. 112+25± to "P" Sta. 124+15±
Do not disturb R/W E. bank
Ramp 15%± See Note 4
Install 12' wide Ramp Connection to existing grade
Relocate exist. guy anchor by others
Install concrete channel extension W. bank, See 3/22
Remove exist. concrete W. bank
Remove exist. CL-6
Remove exist. wire fence
Construct Temporary Fence Engineer to approve location
Install project sign See 1/22
BM E-111 USC&GS Brass Disc. Elev. 33.74
Exist. Dbl. RCB
Tie to exist. CL-6
Freeway R/W
Exist. P.G.&E. Tower
Exist. P.G.&E. Guy & Anchor
Exist. A.C. roadway See Note 6
Conform to exist. A.C. roadway
Exist. Pole, Guy & Anchor
Exist. Concrete Ramp
Exist. Drop Structure
Exist. Toe
Exist. Top
Exist. Socked Concrete
Exist. Wire Fence
Exist. Light Standard
Exist. Gate
Exist. Curb
Exist. Sign
Exist. Channel
Exist. Hwy. 101 R.C.B.
Exist. drop 4.5'
Exist. channel bottom
Grouted rock
Top of rock lining
Top of rock lining E.W. maintenance rd.
Top of levee both banks
Water surface profile for 1% flow
Top of exist. W. bank
Top of exist. E. bank
Top of exist. W. wall
Top of exist. E. wall
Top of exist. A.C. roadway
Top of W. levee El. 34.9 + Conform
Top of exist. headwall. Elev. 35.74
Top of east levee El. 35.8 ± conform to exist. wingwall
Top of channel lining extension W. bank
Top of rock lining
Top of W. levee
Top of E. levee
Top of exist. E. bank
Top of exist. W. bank
Top of levee both banks
W. ramp S=14%±
W. ramp S=13%±
W. ramp S=11%±
E. ramp S=12.0%±
Channel bottom
Toe of rock lining
Grouted rock
Existing Sacked Rip Rap Culvert
Conform to E. bank
Conform to exist. grade
Conform to exist. wingwall
Conform to exist. channel
Conform to exist. ramp
Conform to exist. bank
Conform to exist. levee
Conform to exist. wall
Conform to exist. roadway
Conform to exist. channel bottom
Conform to exist. drop structure
Conform to exist. curb
Conform to exist. concrete
Conform to exist. wire fence
Conform to exist. light standard
Conform to exist. gate
Conform to exist. sign
Conform to exist. guy & anchor
Conform to exist. pole
Conform to exist. tower
Conform to exist. top
Conform to exist. toe
Conform to exist. socked concrete





REV.	DESCRIPTION	DATE	APPR.
1	Existing Field Condition.		D.A.
2	Existing Field Condition.		D.A.
3	Sacked Rip-Rap Widened to Accommodate 6" C.M.P. that was Off Center of 42" C.M.P.	10-2-82	D.A.
4	15" C.M.P. & Drainage Swale Installed Under Permit #82111.	10-11-82	D.A.

REFERENCE INFORMATION AND NOTES

1. For typical sections see A/11
2. Existing fence to remain between Sta. 121+40 and 131+60.
3. Trees 22 thru 39 to be relocated by others. See 1/9
4. Allow 3' min. between temporary fence and exist. structures & fences.
5. Contractor shall deliver the existing wood fence to the Manager of Santiago Villa Mobile Home Park.
6. East bank side slope varies from 1.75:1 to 2:1 range between "P" Sta. 126+71 and 140+16.

PHOTOGRAPHY BY: AIR FLIGHT SERVICE DATE: 6/10/81 RECTIFICATION BY: AIR FLIGHT SERVICE

DATE 3-1-82
DESIGN S.L.E.I. G. FOWLER
DRAWN G.R.S.
CHECKED J. Pandit

Santa Clara Valley Water District

ENGINEERING CERTIFICATION
PROJECT ENGINEER R.C.E. No. 19214
David M. McNeely
DIVISION ENGINEER R.C.E. No. 18759

STEVENS CREEK

HWY 101 TO SHORELINE PARK

PLAN & PROFILE

SCALE As Shown

SHEET 5 OF 45

11838

REV.	DESCRIPTION	DATE	APPR.
1	Widened Drainage Swale 2'	9-11-82	O.A.
2	Widened Sacked Rip-Rap to Accommodate 60" outfall on a skew.	10-28-82	O.A.

REFERENCE INFORMATION AND NOTES

1. Daylight at east maint. road to exist. bank from "P" Sta. 150+00 ± to 167+50 ±.
2. For typical section, See Sheet 11.
3. Modify back slope of levee as necessary to keep toe of levee 1' from new fence at clothes drying area.
4. Between Sta. 143+00 & Sta. 191+00, remove all trees from the const. area.
5. Daylight excavation at East low flow channel bottom from "P" Sta 141+60 ± to "P" Sta 150+00 ±

PHOTOGRAPHY BY: AIR FLIGHT SERVICE DATE: 6/10/81 RECTIFICATION BY: AIR FLIGHT SERVICE

DATE 3-1-82
DESIGN S. LEI G. FOWLER
DRAWN G.R.S.
CHECKED J. Pandit

Santa Clara Valley Water District

ENGINEERING IDENTIFICATION
PROJECT ENGINEER R.C.E. No. 19214
DIVISION ENGINEER R.C.E. No. 18759

STEVENS CREEK

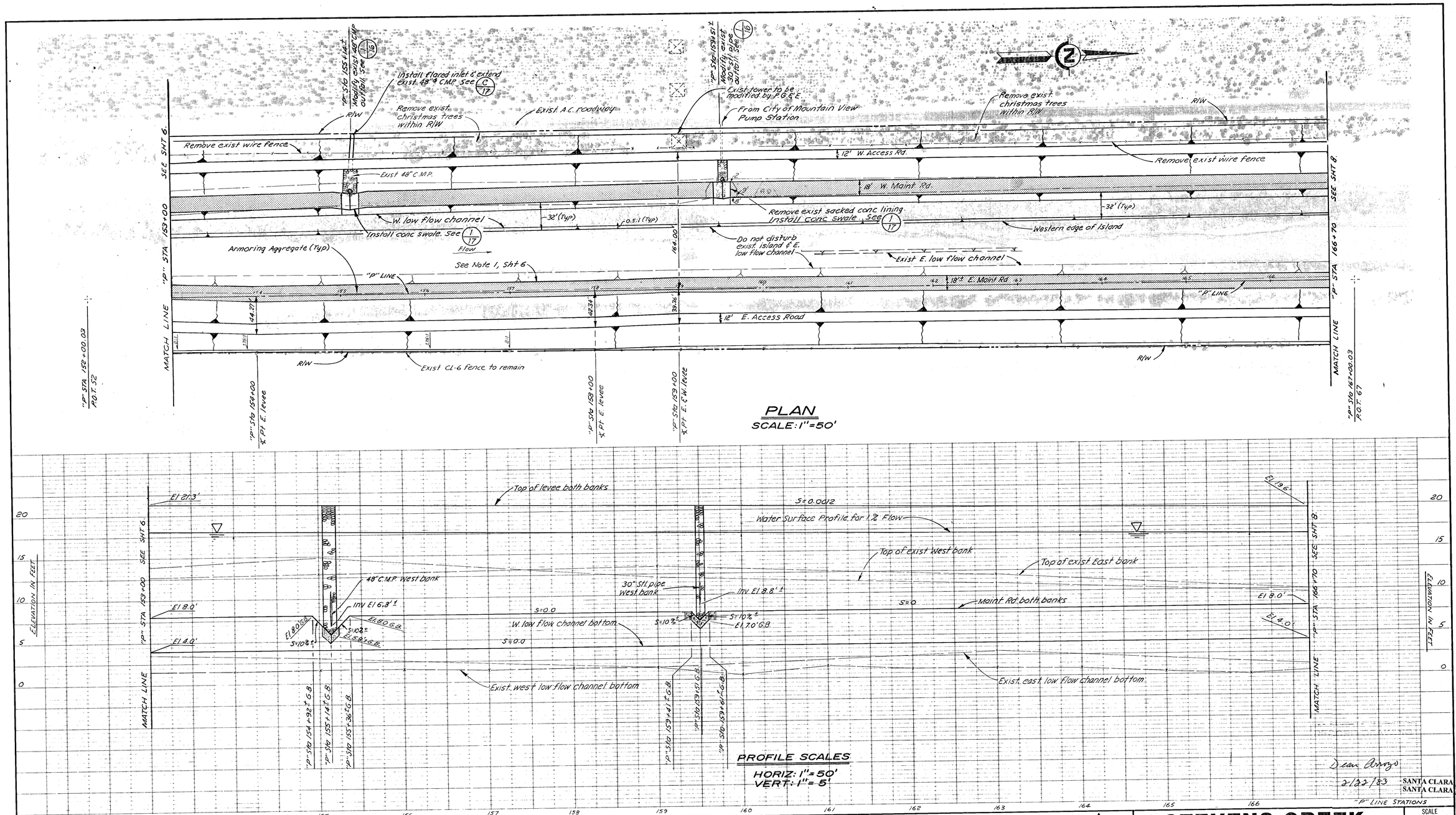
HWY. 101 TO SHORELINE PARK

PLAN & PROFILE

SCALE As Shown

SHEET 6 OF 45

11839



Dean Arroyo
2/22/83

SANTA CLARA CA Work Maps
SANTA CLARA CA0580

REV.	DESCRIPTION	DATE	APPR.
1	Widened Drainage Swale	12-10-82	D.A.

REFERENCE INFORMATION AND NOTES

PHOTOGRAPHY BY: AIR FLIGHT SERVICE DATE: 6/10/81 RECTIFICATION BY: AIR FLIGHT SERVICE

DATE 3-1-82
DESIGN S. LEI G. KOHLER
DRAWN G.R.S.
CHECKED J. Pandit

Santa Clara Valley Water District

ENGINEERING CERTIFICATION
PROJECT ENGINEER R.C.E. No. 19214
DIVISION ENGINEER R.C.E. No. 18759

STEVENS CREEK

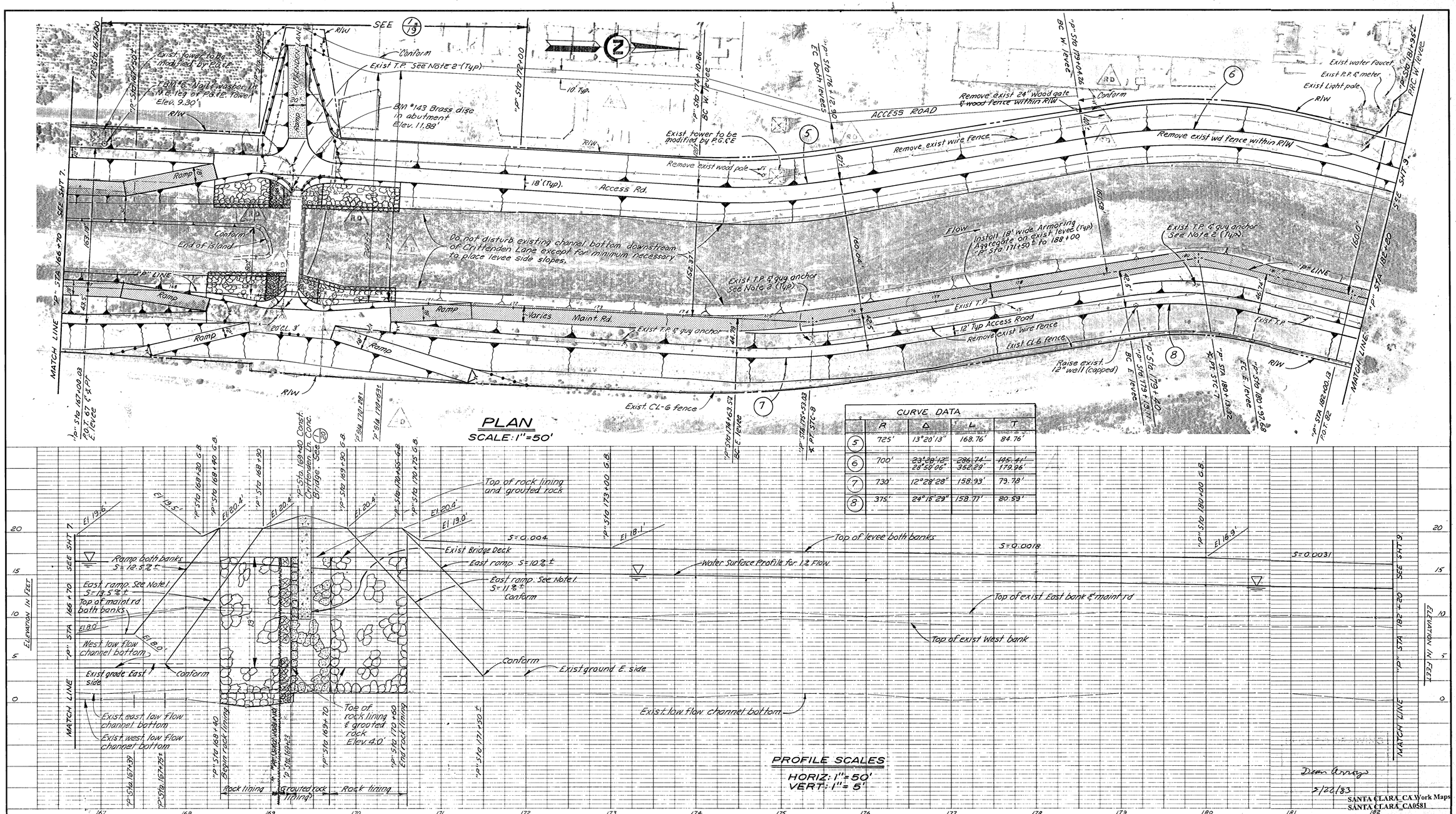
HWY 101 TO SHORELINE PARK

PLAN & PROFILE

SCALE As Shown

SHEET 7 OF 45

11840



	R	Δ	L	T
5	725'	13°20'13"	168.76'	84.76'
6	700'	~~23°28'12"~~ 28°50'06"	~~286.74'~~ 352.29'	~~145.41'~~ 179.96'
7	730'	12°28'28"	158.93'	79.78'
8	375'	24°15'29"	158.77'	80.59'

REV.	DESCRIPTION	DATE	APPR.
1	Construction Change Order. Revised Limits of Grouted Rock.	6-25-82	Q.M.M.
2	Proposed Access Road.	7-15-82	Q.M.M.
3	Changed Curve.		D.A.
4	Additional 6' C.L. Fence.	11-15-82	D.A.
5	Additional 3' C.L. Fence.	11-15-82	D.A.
6	Modified Toe Section.	10-18-82	D.A.

REFERENCE INFORMATION AND NOTES
1. Const ramps on outside slopes of East levee down to exist ground and conform.
2. All exist utility poles & guy anchors within R/W shall be removed by others ("P" Sta. 169+00± to 182+00).

PHOTOGRAPHY BY: AIR FLIGHT SERVICE DATE: 6/10/81 RECTIFICATION BY: AIR FLIGHT SERVICE

DATE 3-1-82
DESIGN S. LEI
DRAWN G.R.S.
CHECKED J. Pandit

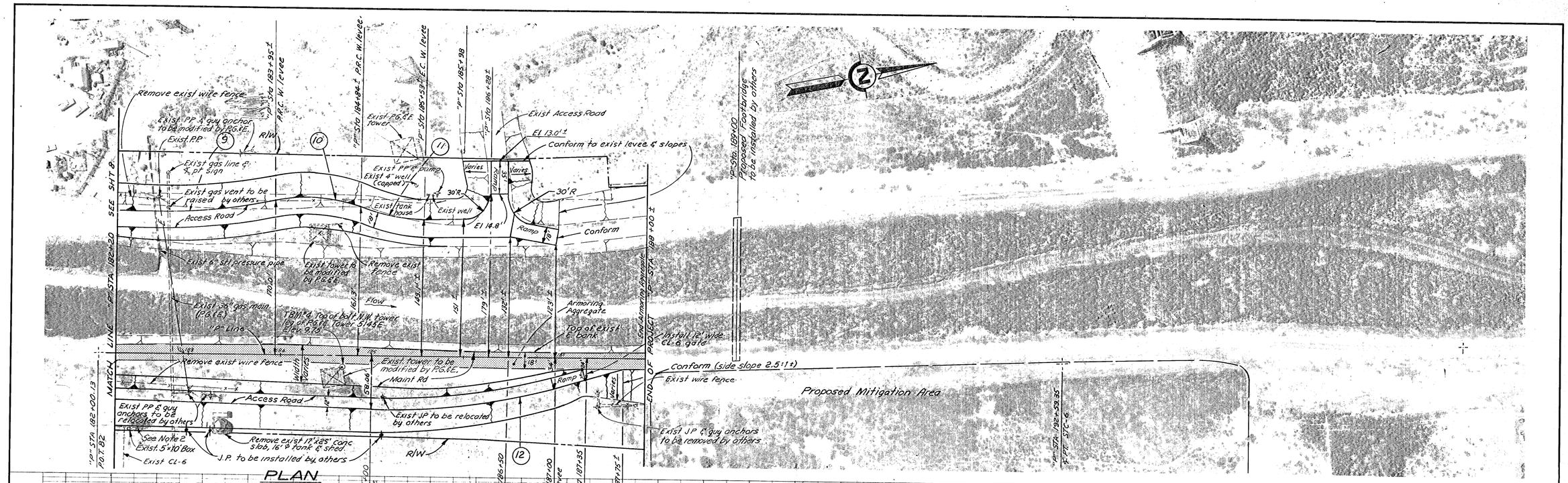
Santa Clara Valley Water District

ENGINEERING CERTIFICATION
PROJECT ENGINEER R.C.E. No. 19214
DIVISION ENGINEER R.C.E. No. 18759

STEVENS CREEK
HWY 101 TO SHORELINE PARK
PLAN & PROFILE

SCALE As SHOWN
SHEET 8 OF 45

11841



PLAN
SCALE: 1" = 50'

PROFILE SCALES
HORIZ: 1" = 50'
VERT: 1" = 5'

TABLE 1/9
TREES SHOWN BY NUMBERS ON THE DRAWINGS

1.	9 - 4" to 8" Cottonwood	20.	3 - 12" staked cluster, 12' apart	39.	1" Poplar staked 15' apart
2.	1 - 10", 2 - 6" Locust	21.	2" Plum	40.	1" Poplar staked 15' apart
3.	16" Locust	22.	1" Poplar staked 15' apart	41.	12" Pine
4.	18" Loquat	23.	1" Poplar staked 15' apart	42.	7 - 6" Hedgerow trees
5.	18" Sycamore	24.	1" Poplar staked 15' apart	43.	12" Redwood
6.	15" Eucalyptus	25.	1" Poplar staked 15' apart	44.	12" Pine
7.	20" Eucalyptus	26.	1" poplar staked 15' apart	45.	9" Pine
8.	20" Oak	27.	1" Poplar staked 15' apart	46.	14" Pine
9.	15" Eucalyptus	28.	1" Poplar staked 15' apart	47.	18" Pine
10.	12" Eucalyptus	29.	1" Poplar staked 15' apart	48.	22" Pine
11.	24" Eucalyptus	30.	1" Poplar staked 15' apart	49.	16" Pine
12.	30" Cottonwood	31.	1" Poplar staked 15' apart	50.	16" Pine
13.	3" to 6" Cottonwood	32.	1" Poplar staked 15' apart	51.	14" Acacia
14.	5 - 10" Cottonwood	33.	1" Poplar staked 15' apart	52.	18" Pine
15.	8" Cottonwood	34.	1" Poplar staked 15' apart	53.	2" Acacia
16.	10" & 12" Cottonwood	35.	1" Poplar staked 15' apart	54.	20" Acacia
17.	5" Plum	36.	1" Poplar staked 15' apart	55.	8" Acacia
18.	4 - 1" Poplar cluster 10' apart	37.	1" Poplar staked 15' apart	56.	6" Acacia
19.	12" Poplar, staked	38.	1" Poplar staked 15' apart	57.	18" Acacia

CURVE DATA

	9	10	11	12
R	700'	200'	200'	700'
Δ	16°24'	20°	20°	16°
L	200.36'	69.81'	69.81'	195.48'
T	100.87'	35.27'	35.27'	98.38'

Dean Arroyo
2/23/82

SANTA CLARA_CA Work Maps
SANTA CLARA_CA0582

REV.	DESCRIPTION	DATE	APPR.

REFERENCE INFORMATION AND NOTES
1. No depressed road on West bank. 18' service road on top West levee.
2. Modify back slope of levee as necessary to keep toe of levee 1' from exist. box.

PHOTOGRAPHY BY: AIR FLIGHT SERVICE DATE: 6/10/81 RECTIFICATION BY: AIR FLIGHT SERVICE

DATE 3-1-82
DESIGN S. Ei, G. Fowler
DRAWN G.R.S.
CHECKED J. Pandit

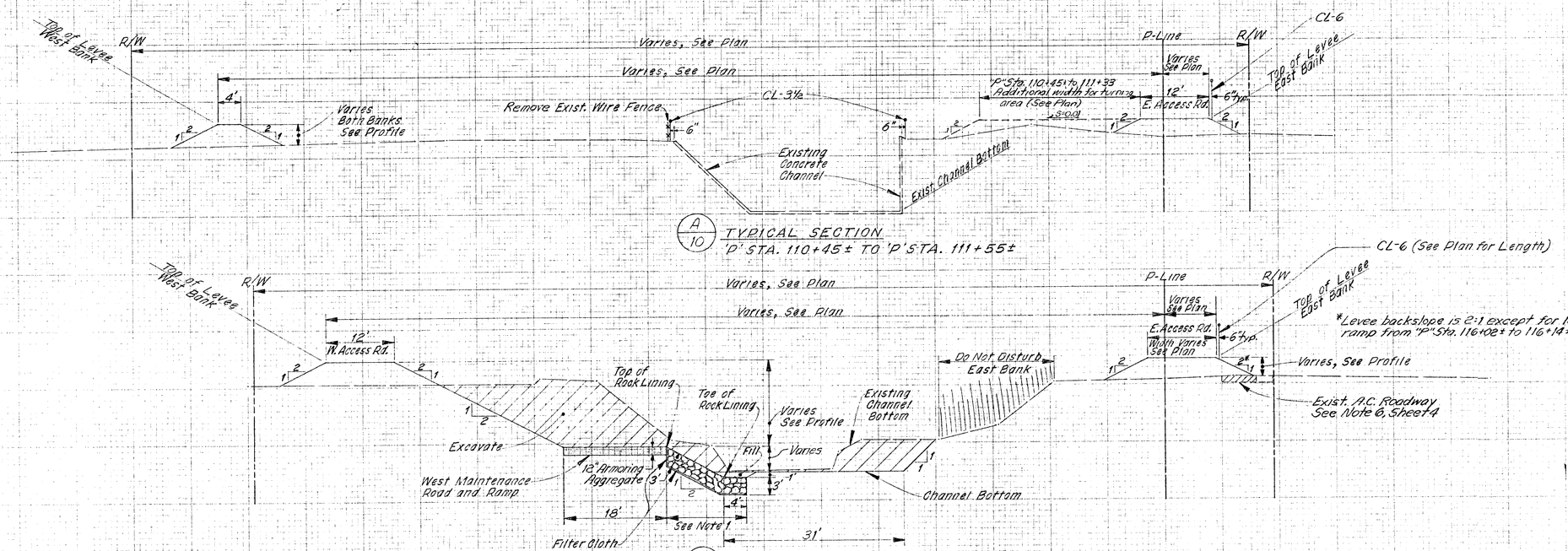
Santa Clara Valley Water District

ENGINEERING CERTIFICATION
PROJECT ENGINEER R.C.E. No. 19214
DIVISION ENGINEER R.C.E. No. 18759

STEVENS CREEK
HWY 101 TO SHORELINE PARK
PLAN & PROFILE

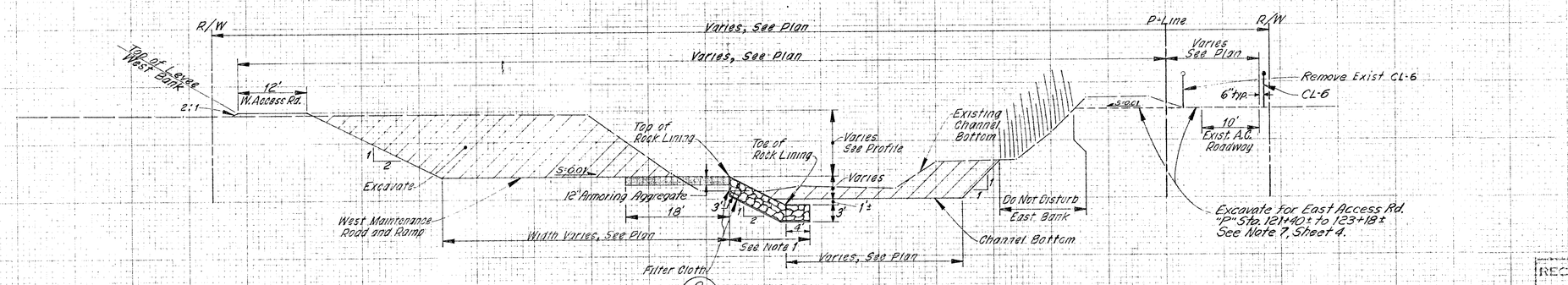
SCALE As Shown
SHEET 9 OF 45

11842



A/10 TYPICAL SECTION
'P' STA. 110+45± TO 'P' STA. 111+55±

B/10 TYPICAL SECTION
'P' STA. 113+00± TO 'P' STA. 117+68±



C/10 TYPICAL SECTION
'P' STA. 120+00± TO 'P' STA. 123+18±

RECORD DRAWING
PROJECT SUPERVISOR
BY Dan Ciraso
DATE 2/22/83

SANTA CLARA_CA Work Maps
SANTA CLARA_CA0583

REFER TO TRACING FOR LATEST REVISION			
REV.	DESCRIPTION	SUB.	APPR.

REFERENCE INFORMATION AND NOTES

1. Install Filter Cloth Beneath the Rock as Shown.
2. Grade All Roads to Drain to Channel (S=0.01).
3. Modify Outside Levee Slopes if Necessary to Maintain Minimum 1 Foot from R/W to Toe of Slopes.
4. See Plan for Reaches Between Typical Sections.

DATE 3-1-82
DESIGN Fowler/Lei
DRAWN F. S. W.
CHECKED J. Pandit

Santa Clara Valley Water District

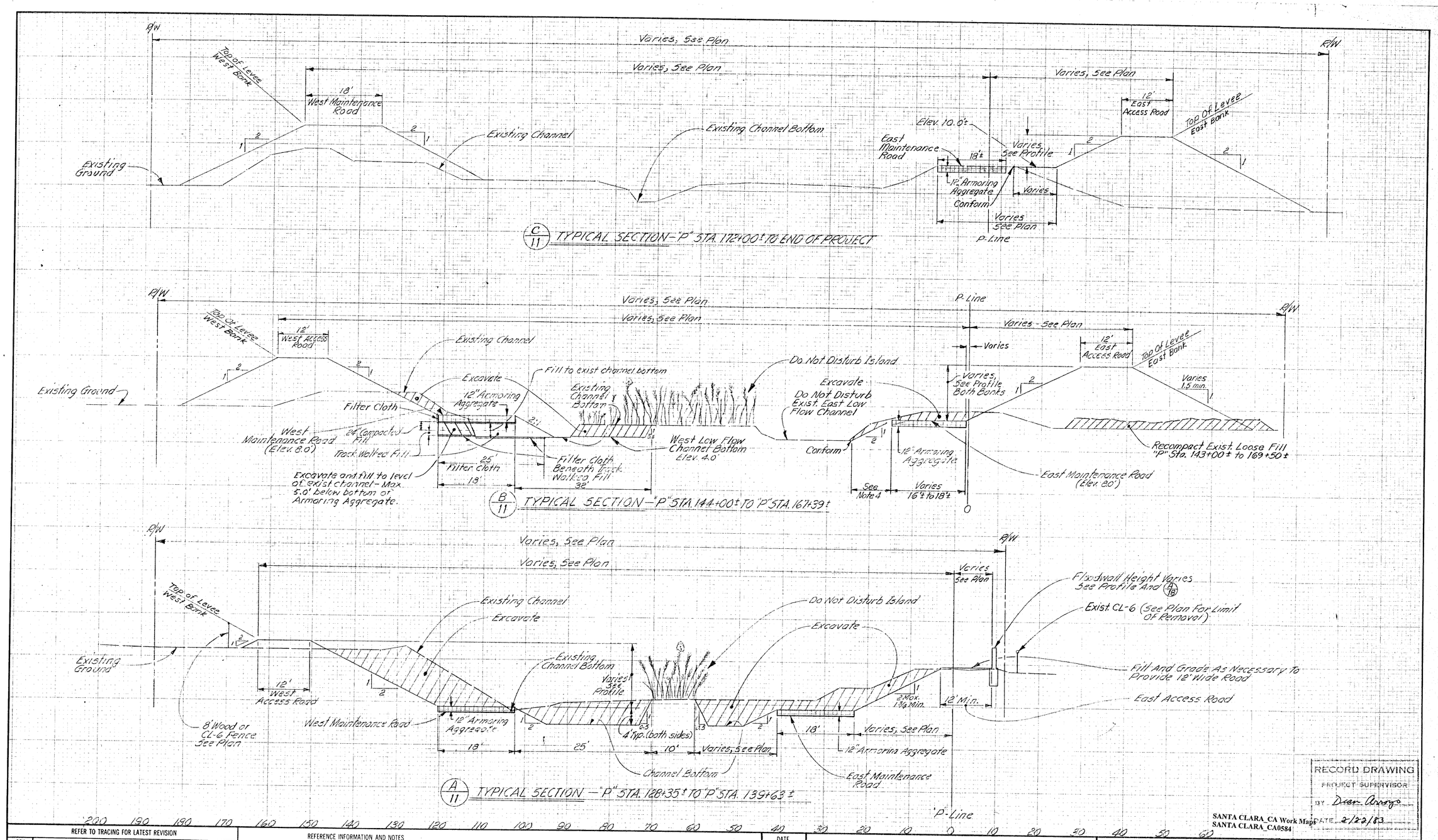
ENGINEERING CERTIFICATION
PROJECT ENGINEER R.C.E. No. 19214

ENGINEERING APPROVAL
DIVISION ENGINEER R.C.E. No. 18759

STEVENS CREEK
HWY 101 TO SHORELINE PARK
TYPICAL SECTIONS

SCALE N.T.S.
SHEET 10 OF 45

11843



RECORD DRAWING
PROJECT SUPERVISOR
BY Dean Arroyo
DATE 2/22/83

SANTA CLARA_CA Work Maps
SANTA CLARA_CA0584

REFER TO TRACING FOR LATEST REVISION

REV.	DESCRIPTION	SUB.	APPR.

REFERENCE INFORMATION AND NOTES

1. Grade All Roads to Drain to Channel (S=0.01)
2. Modify Outside Levee Slopes If Necessary To Maintain Minimum 1 Foot From R/W To Toe Of Slopes
3. See Plan For Reaches Between Typical Sections.
4. Except From "P" Sta. 150+00± To 167+50± Daylight At East Maintenance Road To Exist. Bank.

DATE 3-1-82
DESIGN S.L.E. / G. FOWLER
DRAWN G.E.S. / S.W.
CHECKED J. Pandit

Santa Clara Valley Water District

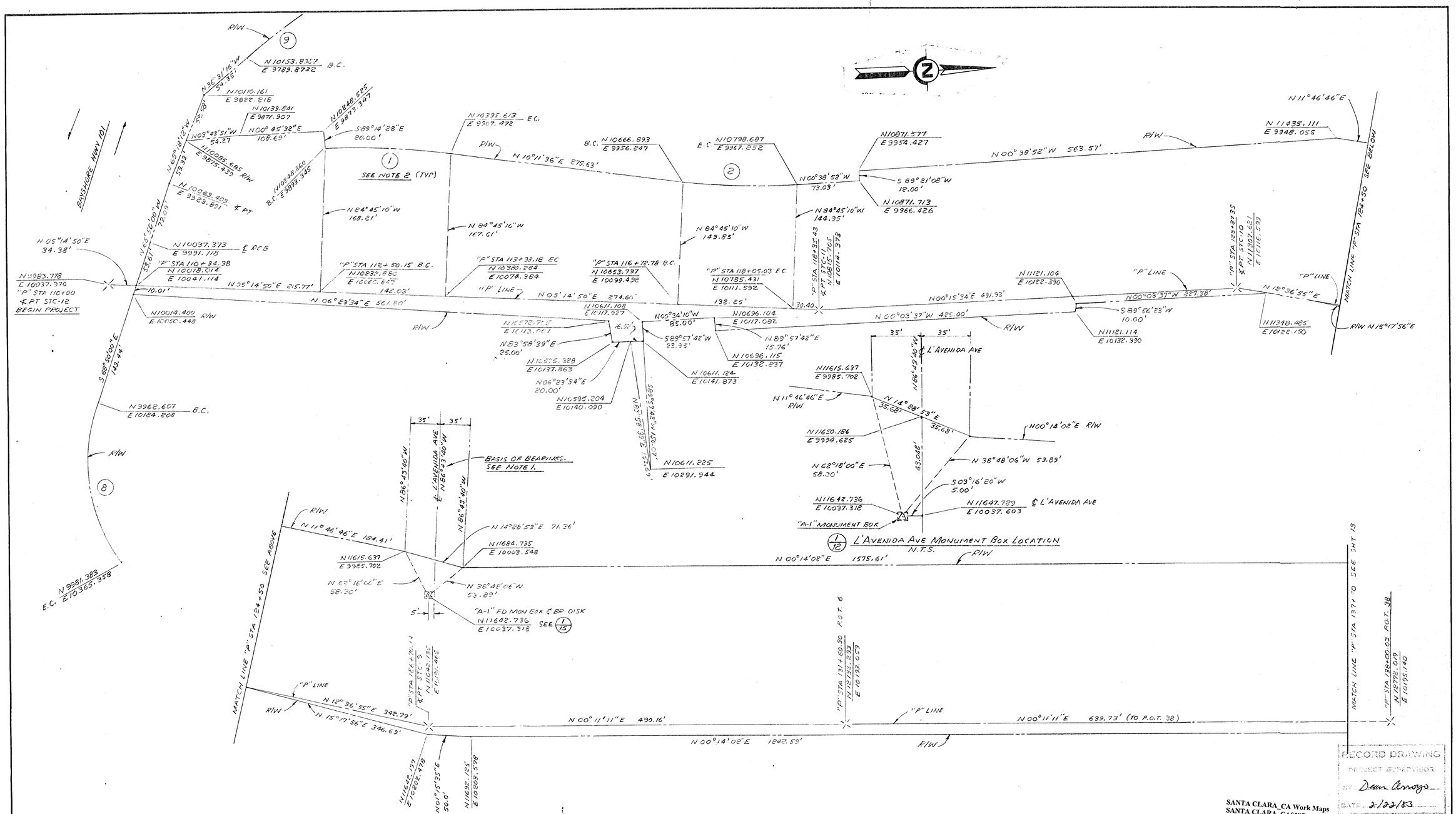
ENGINEERING CERTIFICATION
PROJECT ENGINEER R.C.E. No. 19214

ENGINEERING APPROVAL
DIVISION ENGINEER R.C.E. No. 18759

STEVENS CREEK
HWY 101 TO SHORELINE PARK
TYPICAL SECTIONS

SCALE N.T.S.
SHEET 11 OF 45

11844



RECORD DRAWING
PROJECT SUPERVISOR
BY Dean Arroyo
DATE 2/22/83

SANTA CLARA_CA Work Maps
SANTA CLARA_CA0585

REV.	DESCRIPTION	DATE	APPR.

REFERENCE INFORMATION AND NOTES
1. The ℄ of L'Avenida Ave, shown as S87°00'00"E on that certain Record of Survey Field Book 274 of maps at page 24, Santa Clara County Records, was taken as S 86°43'40"E as the Basis of Bearings.
2. Curve Data. See Sht

DATE 3-1-82
DESIGN Leil Fowler
DRAWN G. SIGNOR
CHECKED J. Pandit

Santa Clara Valley Water District

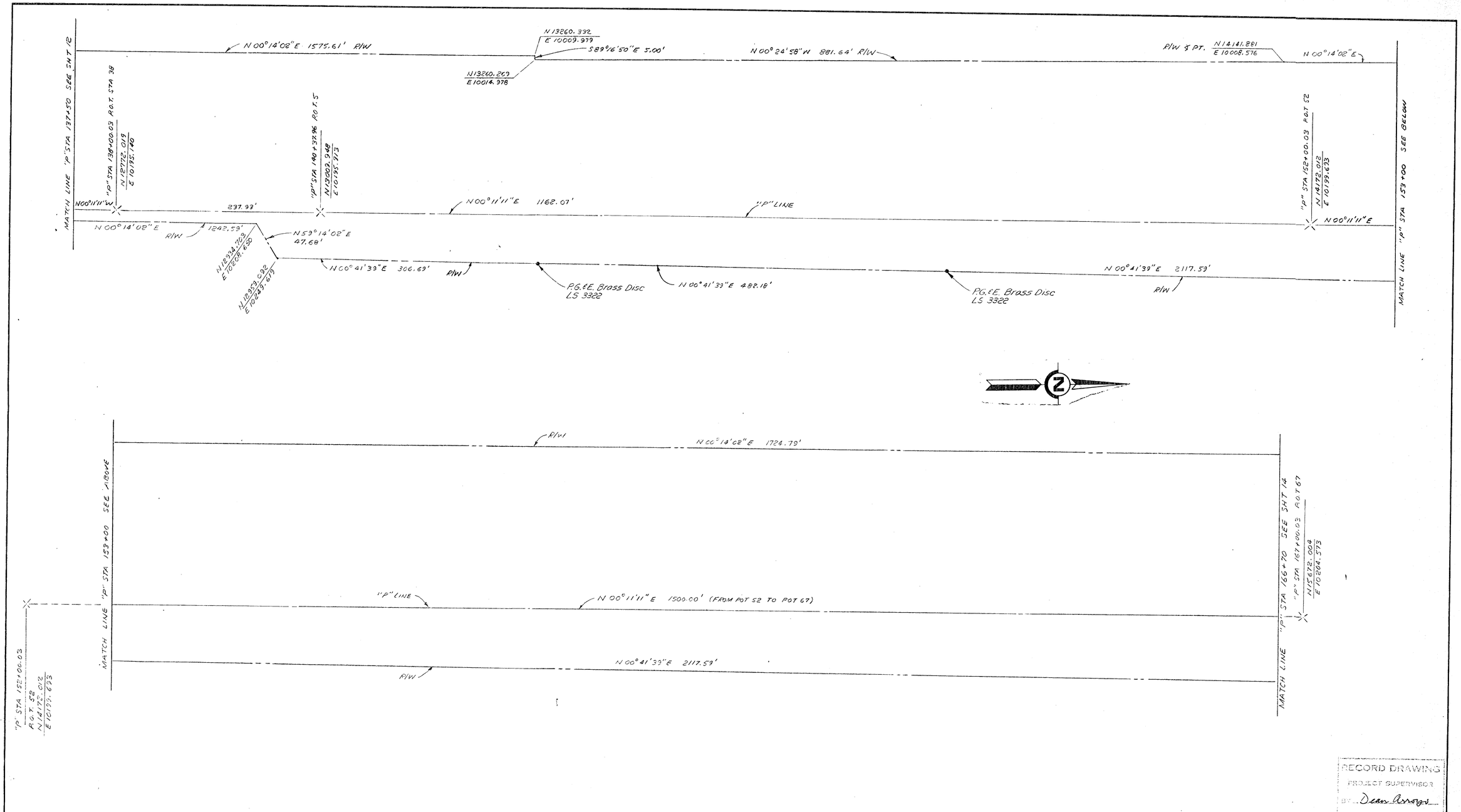
ENGINEERING CERTIFICATION
PROJECT ENGINEER R.C.E. No. 19214

ENGINEERING APPROVAL
DIVISION ENGINEER R.C.E. No. 18759

STEVENS CREEK
HWY 101 TO SHORELINE PARK
LAYOUT

SCALE 1"=50' & AS SHOWN
SHEET 12 OF 45

11845



RECORD DRAWING
PROJECT SUPERVISOR
BY Dean Arroyo
DATE 2/22/83

SANTA CLARA_CA Work Maps
SANTA CLARA_CA0586

REV.	DESCRIPTION	DATE	APPR.	REFERENCE INFORMATION AND NOTES

DATE 3-1-82
DESIGN Lei/Fowler
DRAWN G. Sysinger
CHECKED J. Pandit

Santa Clara Valley Water District

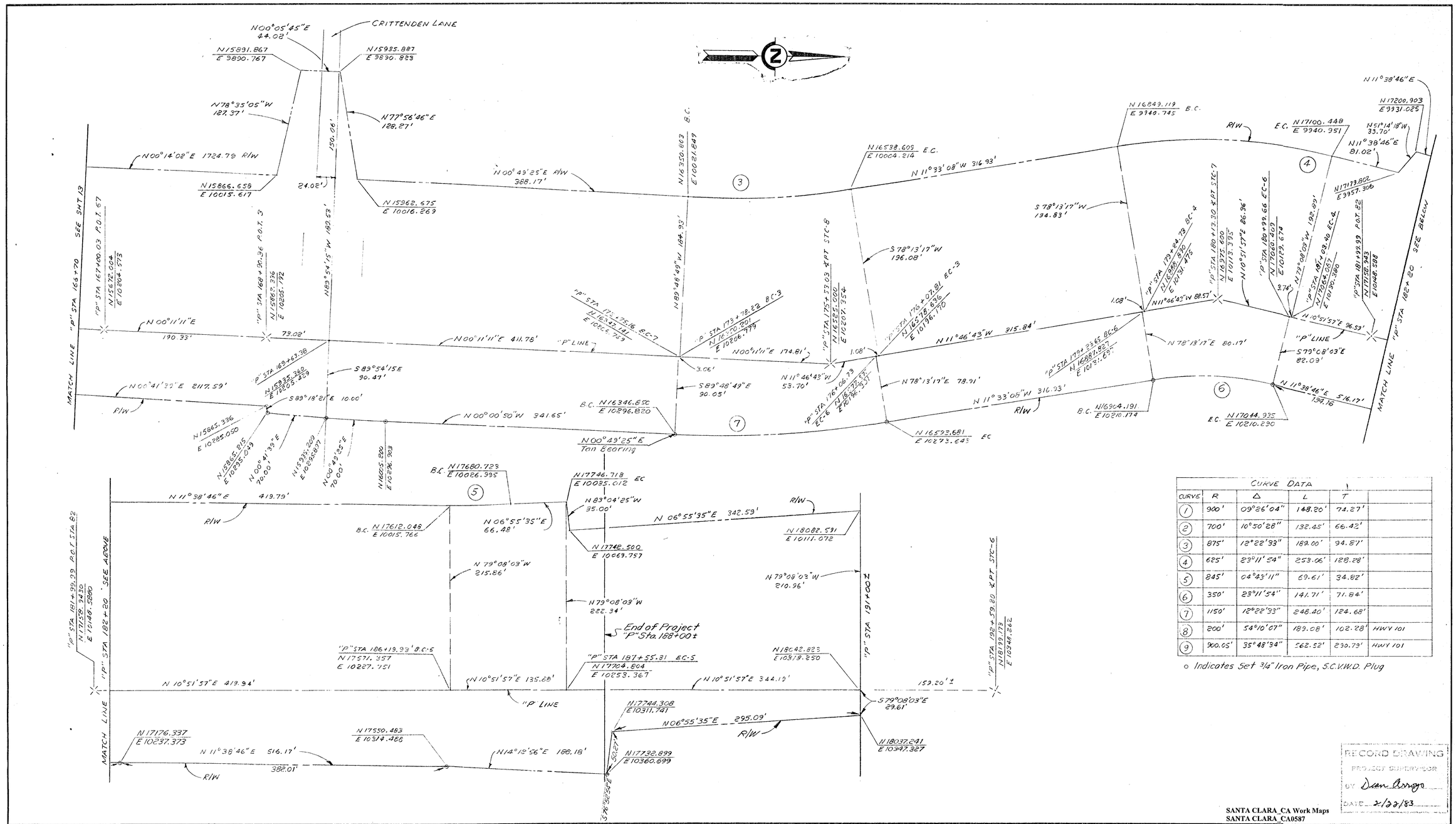
ENGINEERING CERTIFICATION
PROJECT ENGINEER R.C.E. No. 19214

ENGINEERING APPROVAL
DIVISION ENGINEER R.C.E. No. 18759

STEVENS CREEK
HWY 101 TO SHORELINE PARK
LAYOUT

SCALE 1" = 50'
SHEET 13 OF 45

11846



CURVE DATA					
CURVE	R	Δ	L	T	
1	900'	09°26'04"	148.20'	74.27'	
2	700'	10°50'28"	132.45'	66.42'	
3	875'	12°22'33"	189.00'	94.87'	
4	625'	23°11'54"	253.06'	128.28'	
5	845'	04°43'11"	69.61'	34.82'	
6	350'	23°11'54"	141.71'	71.84'	
7	1150'	12°22'33"	248.40'	124.68'	
8	200'	54°10'07"	189.08'	102.28'	HWY 101
9	900.05'	35°48'34"	562.52'	290.79'	HWY 101

○ Indicates Set 3/4" Iron Pipe, S.C.V.W.D. Plug

RECORD DRAWING
PROJECT SURVEYOR
BY Dan Arroyo
DATE 2/27/83

SANTA CLARA_CA Work Maps
SANTA CLARA_CA0587

REV.	DESCRIPTION	DATE	APPR.	REFERENCE INFORMATION AND NOTES

DATE 3-1-82
DESIGN Leif Fowler
DRAWN G. SIGNOR
CHECKED J. Pandit

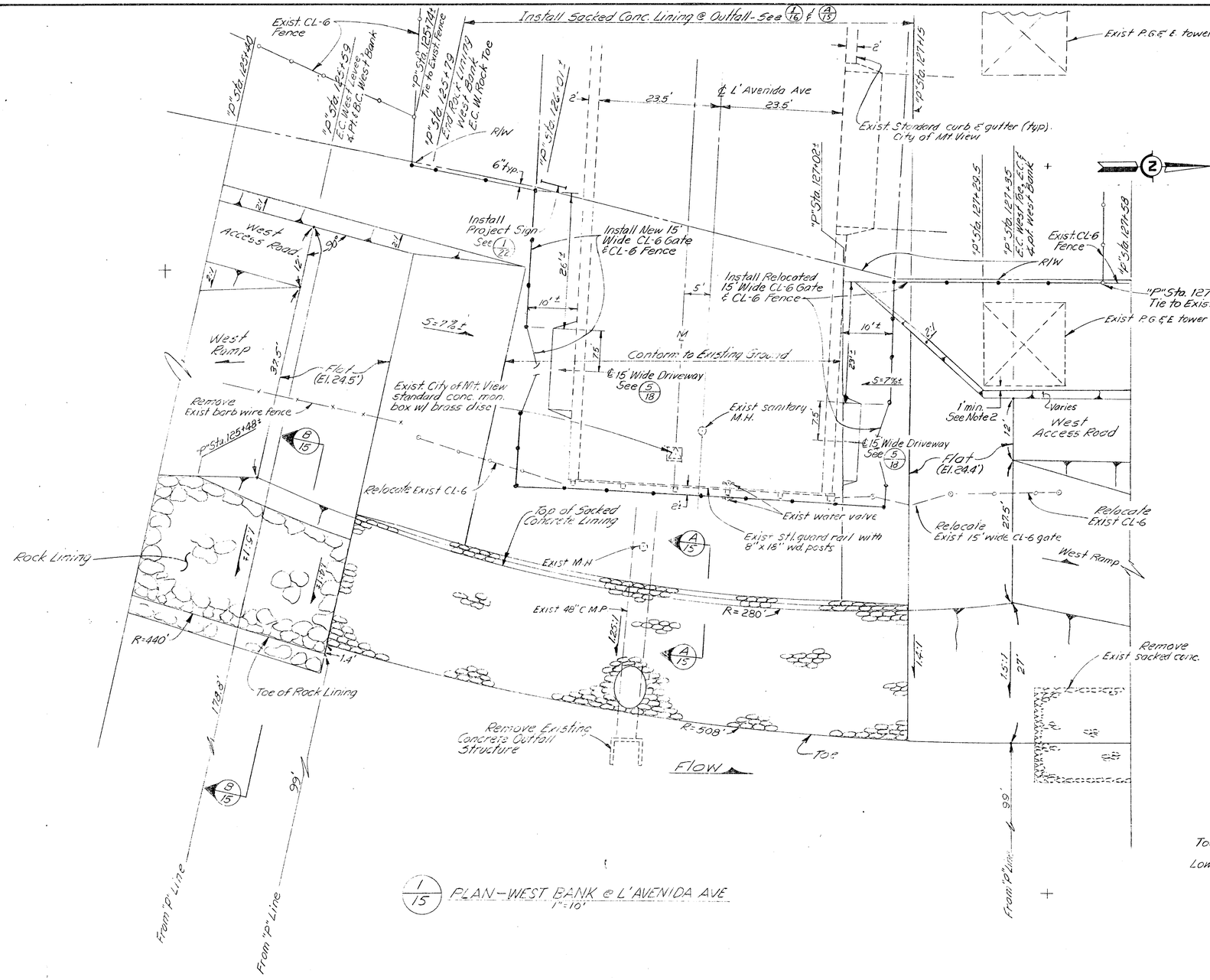
Santa Clara Valley Water District

ENGINEERING CERTIFICATION — PROJECT ENGINEER — R.C.E. No. 19214
ENGINEERING APPROVAL — DIVISION ENGINEER — R.C.E. No. 18759

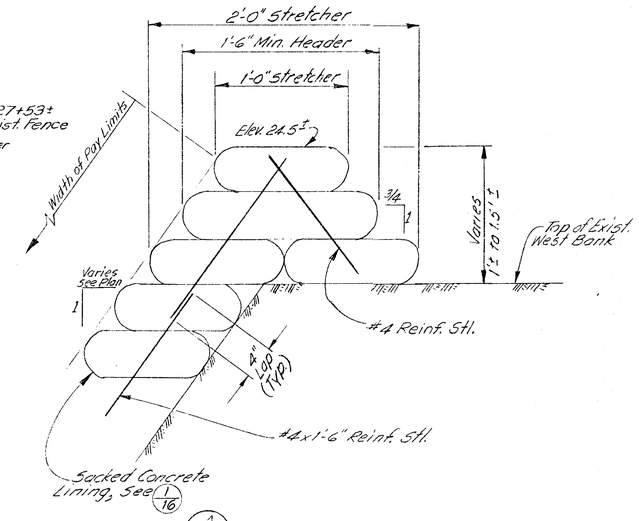
STEVENS CREEK
HWY 101 TO SHORELINE PARK
LAYOUT

SCALE 1" = 50'
SHEET 14 OF 45

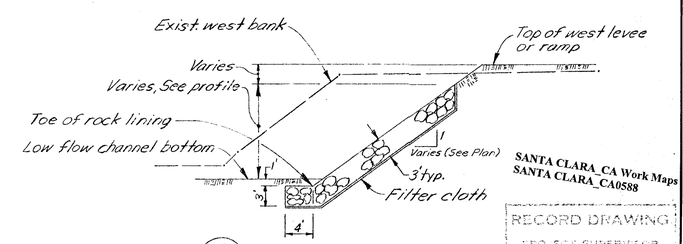
11847



1/15 PLAN-WEST BANK @ L'AVENIDA AVE
1"=10'



A/15 EXTENDED SACKED CONCRETE
See Note 1 N.T.S.



B/15 ROCK LINING
Scale: 1"=10'

SANTA CLARA_CA Work Maps
SANTA CLARA_CA0588

RECORD DRAWING
PROJECT SUPERVISOR
BY Dean Arroyo
DATE 2/22/83

REV.	DESCRIPTION	DATE	APPR.

REFERENCE INFORMATION AND NOTES
1. Extended sacked concrete shall be included in the pay limit for sacked concrete slope protection as shown in 1/16.
2. Modify back slope of levee as necessary to keep toe of levee 1' min. from tower support.

DATE 3-1-82
DESIGN S.LEI
DRAWN GRS
CHECKED J. Pandit

Santa Clara Valley Water District

ENGINEERING CERTIFICATION — PROJECT ENGINEER — R.C.E. No. 19214
ENGINEERING APPROVAL — DIVISION ENGINEER — R.C.E. No. 18759

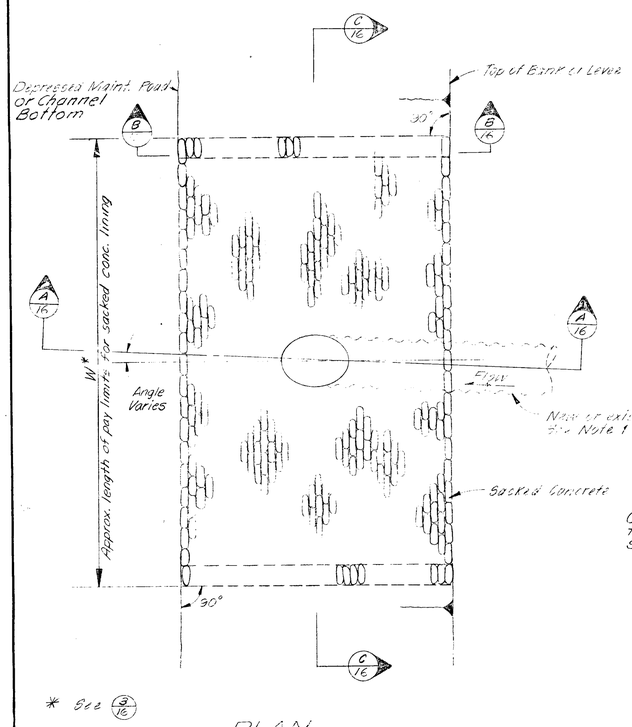
STEVENS CREEK
HWY 101 TO SHORELINE PARK
DETAILS

SCALE AS SHOWN
SHEET 15 OF 45

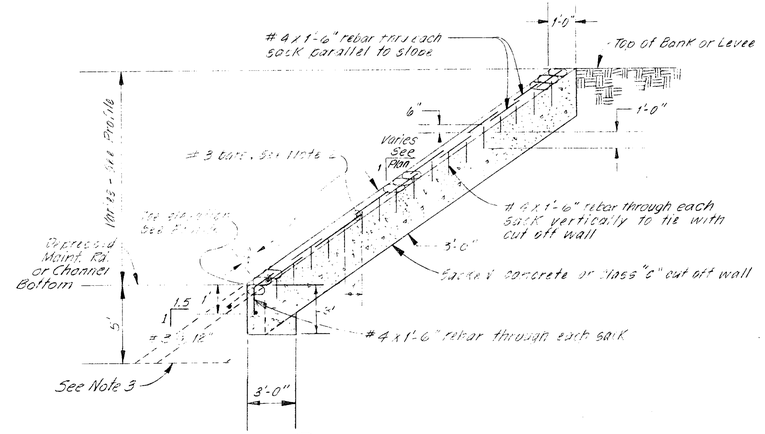
11848

MODIFIED OUTFALL SCHEDULE (3/16)

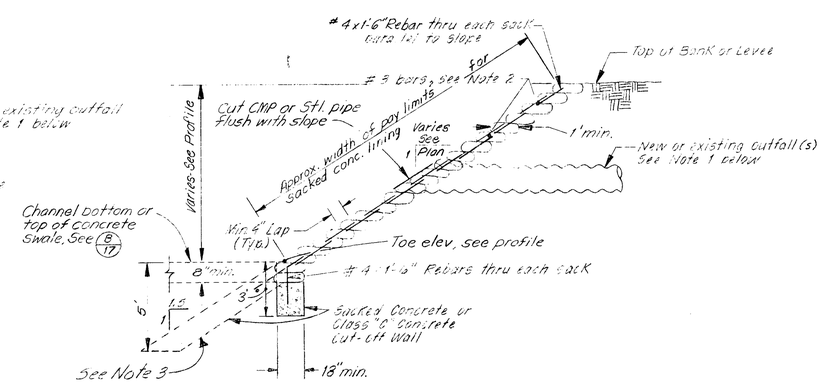
STATION	LOCATION	EXISTING PIPE TYPE & SIZE D1	EXISTING PIPE TO BE REMOVED	FLAPGATE	OUTLET PIPE TYPE & SIZE D2	OUTLET PIPE LENGTH L	OUTLET ELEVATION	W = WIDTH OF SACKED CONCRETE
126+40	W. Bank	43" CMP	12'±	Salvaged	78" CMP, 10 Ga	9'-3"±	7.5'±	See Det (1/16)
128+67±	E. Bank	21" CMP	7'±	NO	No	No	14.3'±	8'
136+30±	W. Bank	6" CMP 21" CMP	21'±	No Salvaged	No 42" CMP, 14 Ga	No 8'-0"	15'± 7.6'±	8'
136+32±	E. Bank	24" CMP	7'±	NO	No	No	10.2'±	~~8'~~ 12
141+80	W. Bank	2-10" CMP 36" CMP	13'±	No Salvaged	No 60" CMP, 12 Ga.	No 11'-0"	12'± 5.1'±	~~18'~~ 16
155+14	W. Bank	48" CMP	15'±	Salvaged	78" CMP, 10 Ga	14'-0"	6.8'±	16'
153+51	W. Bank	30" Steel	7'±	No	No	No	8.8'±	10'



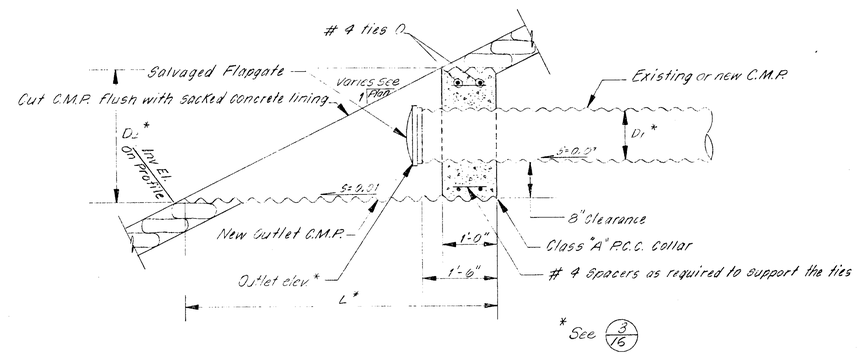
PLAN
N.T.S.



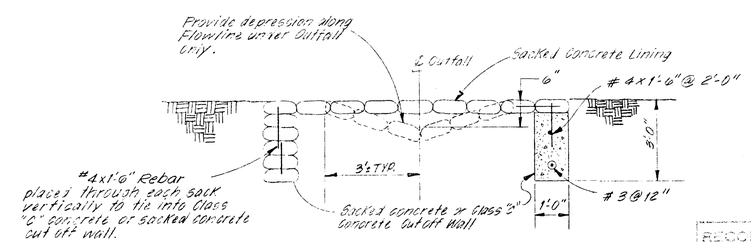
SECTION (B/16) CUT OFF WALL
N.T.S.



SECTION (A/16)
N.T.S.



DETAIL (2/16) OUTFALL WITH FLAPGATE
N.T.S.



SECTION (C/16)
N.T.S.

DETAIL (1/16) SACKED CONCRETE AT OUTFALL
N.T.S.

RECORD DRAWING
PROJECT SUPERVISOR
BY: Dean Arroyo
DATE: 2/22/83

SANTA CLARA_CA Work Maps
SANTA CLARA_CA0589

REV.	DESCRIPTION	DATE	APPR.
1	Increase Width of Sacked Concrete	11-20-80	G.A.
2	Increase Width of Sacked Concrete	10-28-80	G.A.

REFERENCE INFORMATION AND NOTES

1. Outfall may be either the existing CMP that is trimmed or extended to conform to new channel, or new CMP from drainage trucks. Where Flapgates are required, see (2/16)
2. On the top of every 4th course of sacks, place horizontally, a #3 rebar, continuous or lapped 2'-0" where necessary in the longitudinal direction. Tie to the #4 bars inserted through the sacks (min. of every third #4 bar). 3. Provide inclined cut-off wall adjacent to west bank @ L'Avenida Ave.

DATE 3-1-82
DESIGNED S. Lei
DRAWN Levi Hill
CHECKED J. Pandit

Santa Clara Valley Water District

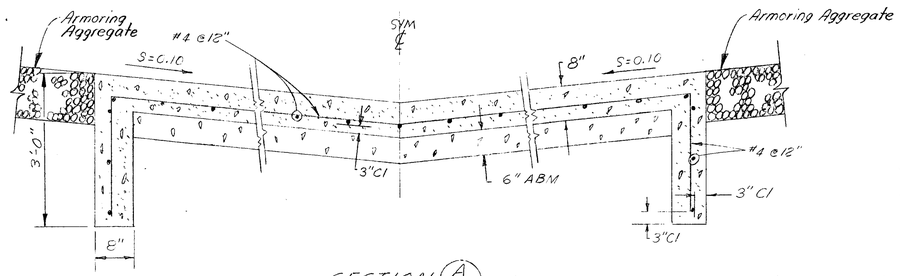
ENGINEERING CERTIFICATION
PROJECT ENGINEER — R.C.E. No. 19214

ENGINEERING APPROVAL
DIVISION ENGINEER — R.C.E. No. 18759

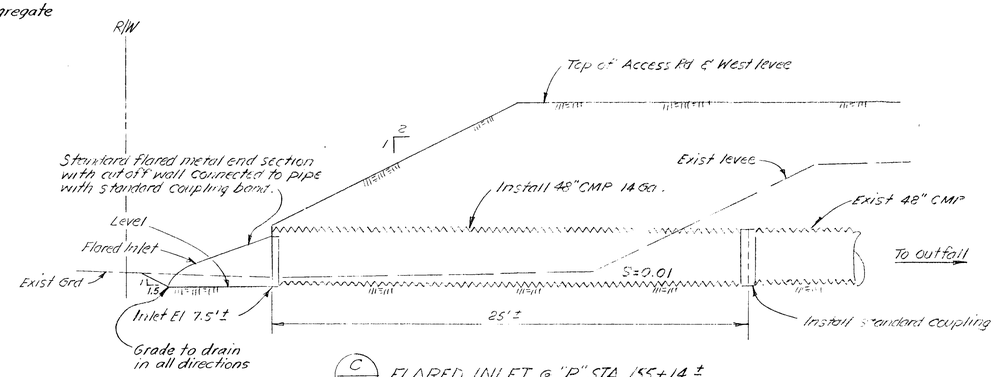
STEVENS CREEK
HWY 101 TO SHORELINE PARK
DETAILS

SCALE As Shown
SHEET 16 OF 45

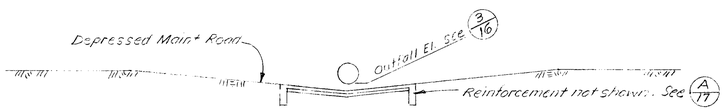
11849



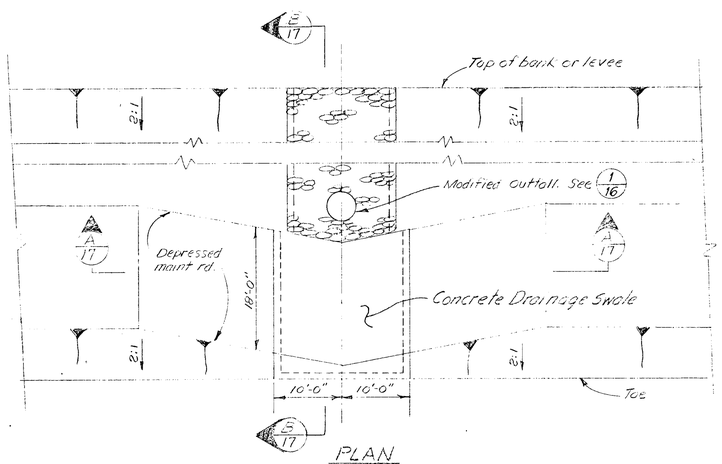
SECTION (A/17)
3/4" = 1'-0



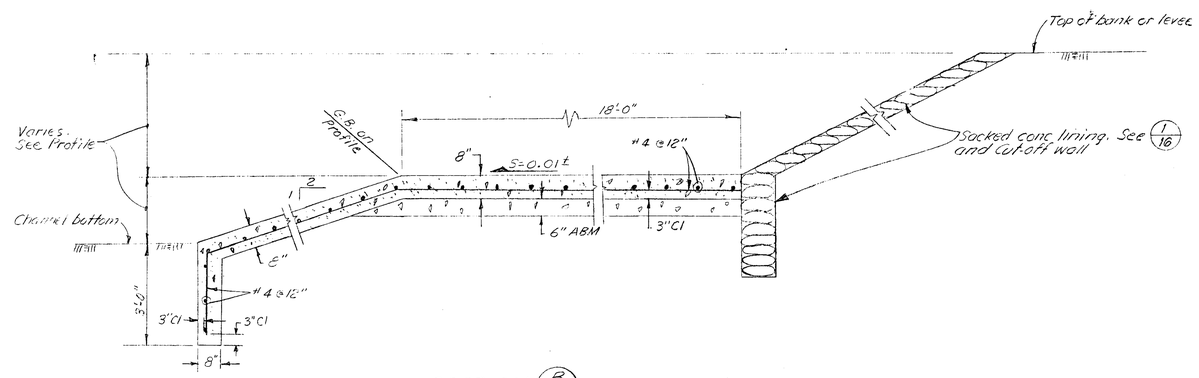
(C/17) FLARED INLET @ "P" STA 155+14 ±
NTS



PROFILE



PLAN



SECTION (B/17)
1/2" = 1'-0"

(1/17) CONCRETE DRAINAGE SWALE
1" = 10'

RECORD DRAWING
PROJECT SUPERVISOR
BY: Dean Arroyo
DATE: 2/22/83

SANTA CLARA_CA Work Maps
SANTA CLARA_CA0590

REV.	DESCRIPTION	DATE	APPR.	REFERENCE INFORMATION AND NOTES

DATE 3-1-82
DESIGN S. LEI
DRAWN G. SIGNOR
CHECKED J. Pandit

Santa Clara Valley Water District

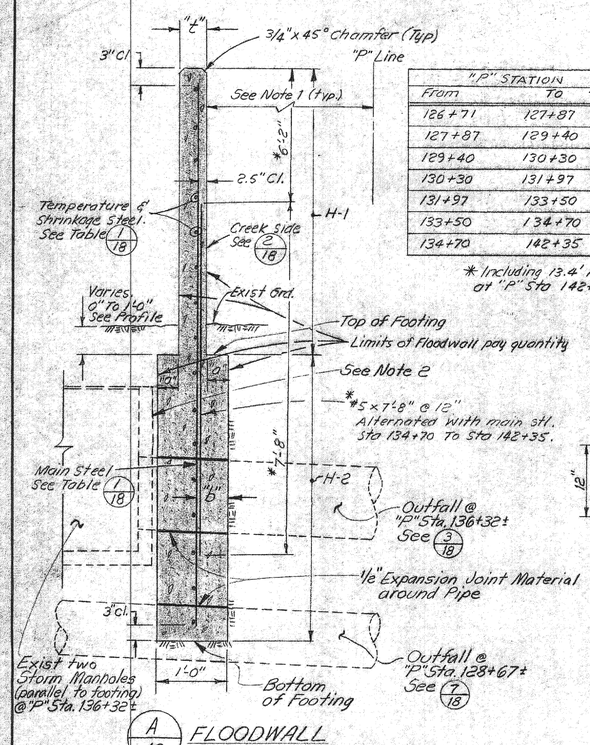
ENGINEERING CERTIFICATION
PROJECT ENGINEER — R.C.E. No. 19214

ENGINEERING APPROVAL
DIVISION ENGINEER — R.C.E. No. 18759

STEVENS CREEK
HWY 101 TO SHORELINE PARK
DETAILS

SCALE AS SHOWN
SHEET 17 OF 45

11850

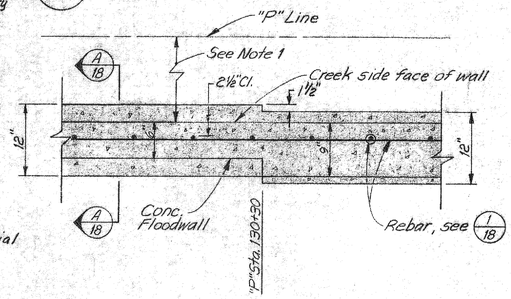


A/18 FLOODWALL
N.T.S.

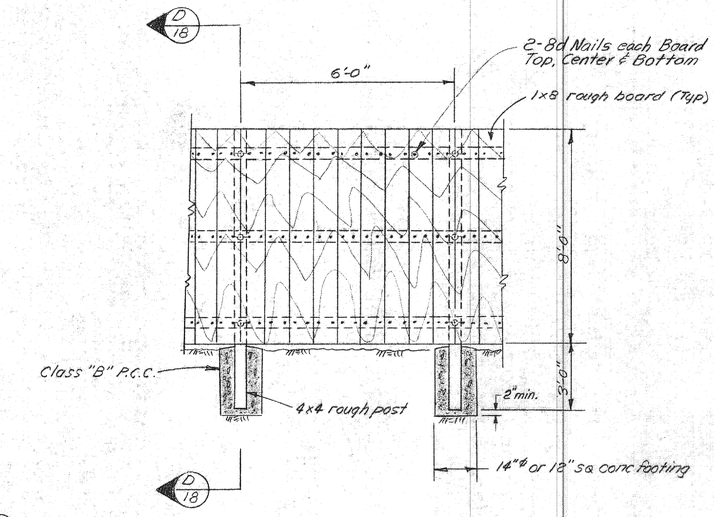
"P" STATION From	"P" STATION To	H-1	H-2	"t"	Main Stl	Temp. & Shrink Stl	"a"	"b"
126+71	127+87	3'-0"	3'-7"	6"	#4@15"	#4@15"	3"	5.5"
127+87	129+40	4'-0"	4'-7"	6"	#4@15"	#4@15"	3"	5.5"
129+40	130+30	5'-0"	5'-3"	6"	#4@12"	#4@15"	3"	5.5"
130+30	131+97	6'-0"	6'-7"	9"	#4@10"	#4@10"	1.5"	4"
131+97	133+50	7'-0"	7'-8"	9"	#6@12"	#4@10"	1.5"	4"
133+50	134+70	7'-0"	9'-4"	9"	#6@12"	#4@10"	1.5"	4"
134+70	142+35 *	8'-0"	8'-5"	9"	#5@12"	#4@10"	1.5	4"

* Including 13.4' length of wall perpendicular to East Access Rd at "P" Sta 142+35.

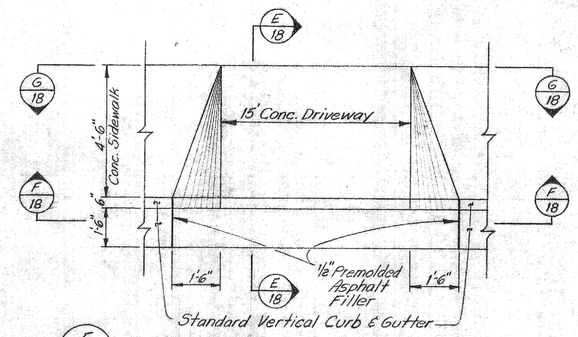
1/18 TABLE



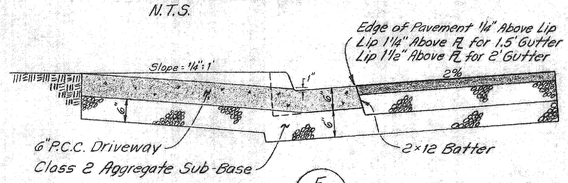
2/18 PLAN-FLOODWALL @ STA. 130+30
N.T.S.



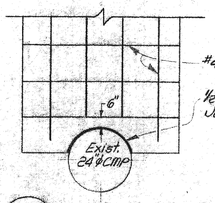
4/18 WOOD FENCE
NTS



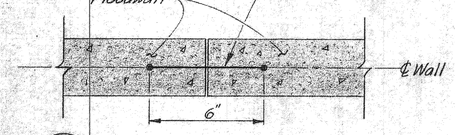
5/18 TYPICAL CONCRETE SIDEWALK AND DRIVEWAY APPROACH - CITY OF MOUNTAIN VIEW
N.T.S.



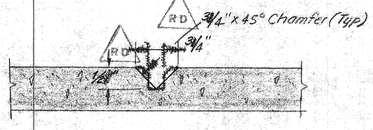
SECTION E/18
N.T.S.



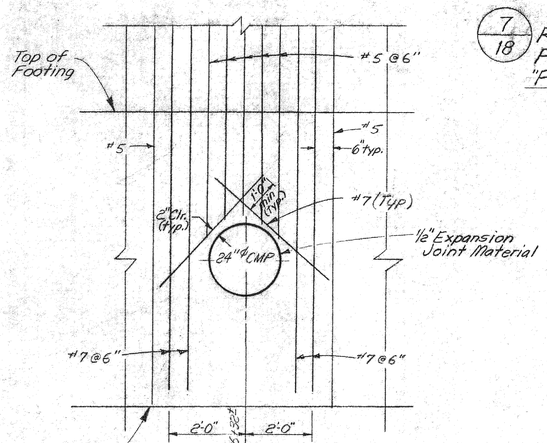
7/18 REINFORCEMENT FOR CMP @ "P" STA. 128+67±
N.T.S.



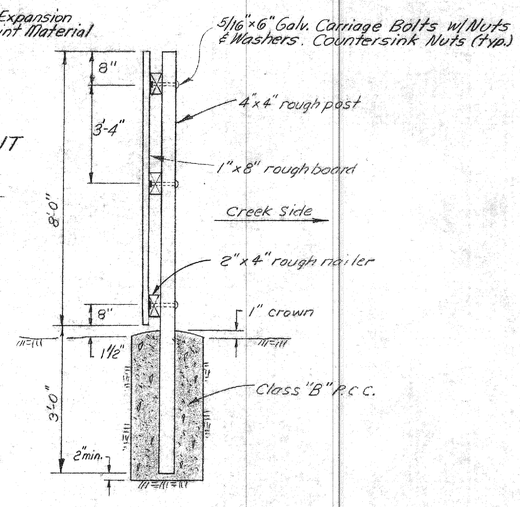
B/18 WATERTIGHT CONSTRUCTION JOINT
N.T.S.



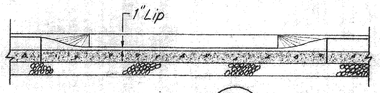
C/18 CONTRACTION JOINT
NTS



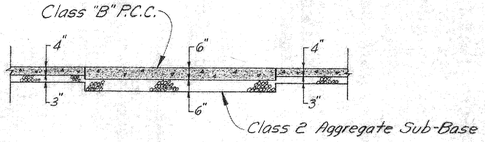
3/18 FOOTING REINFORCEMENT FOR CMP @ STA 136+32±
NTS



D/18 FENCE SUPPORT
NTS



SECTION F/18
N.T.S.



SECTION 6/18
N.T.S.

RECORD DRAWING
PROJECT SUPERVISOR
BY Dean Arroyo
DATE 2/23/83

REV.	DESCRIPTION	DATE	APPR.
1	Modified Contraction Joint	6-25-82	D.A.

REFERENCE INFORMATION AND NOTES

1. Distance to "P"-Line measured from creekside face of floodwall.
2. The gap between exist. storm manholes and the footing is about 6" to 1'±. Clean all contact surfaces of the manholes and pour concrete to fill the gap.

DATE 3-1-82
DESIGN L.E. Fowler
DRAWN G. Signor
CHECKED J. Pandit

Santa Clara Valley Water District

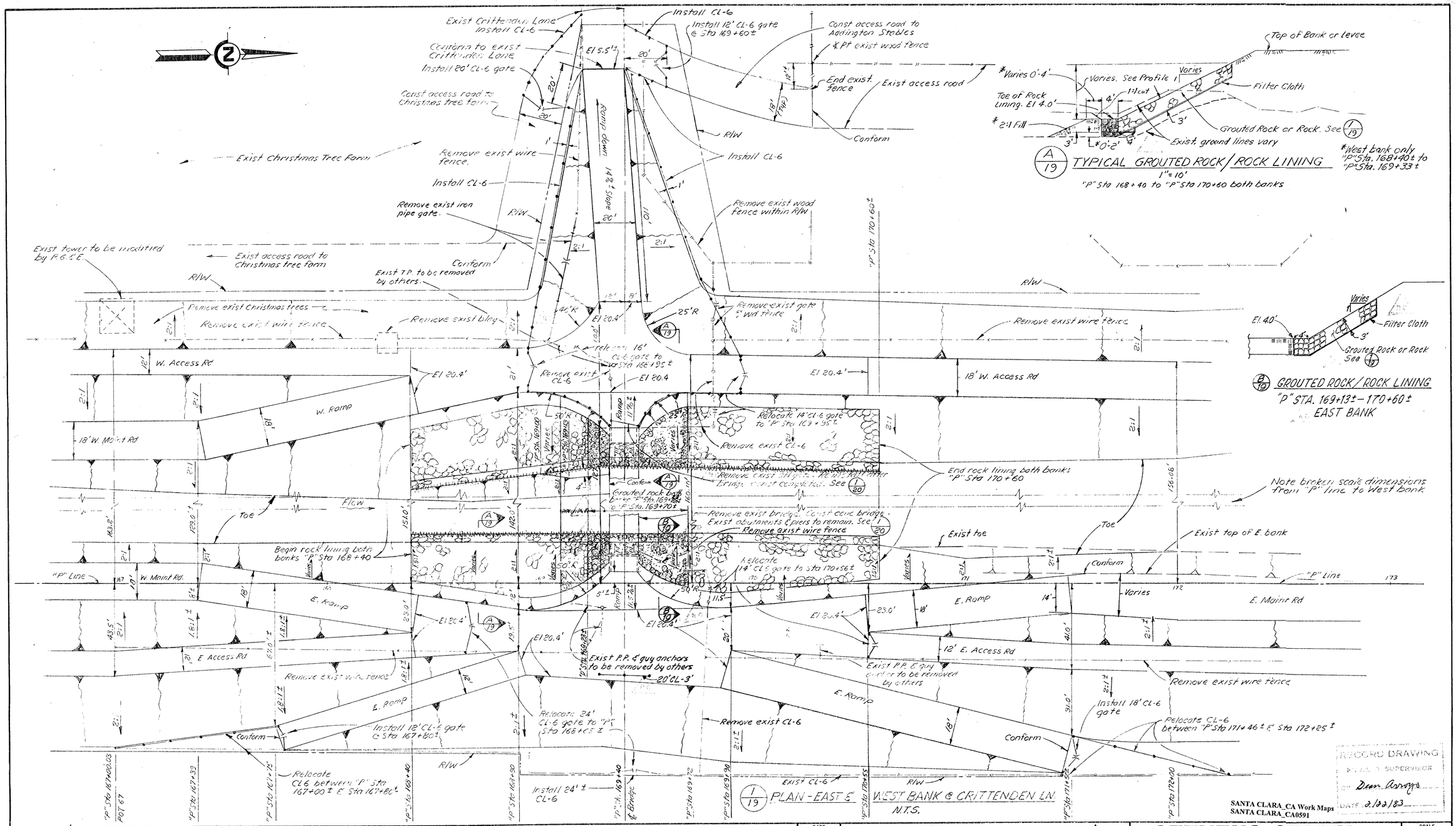
ENGINEERING CERTIFICATION: PROJECT ENGINEER R.C.E. No. 19214
ENGINEERING APPROVAL: DIVISION ENGINEER R.C.E. No. 18759

STEVENS CREEK
HWY 101 TO SHORELINE PARK
DETAILS

SCALE AS SHOWN
SHEET 18 OF 45

11851

1029-17-3-18



REV.	DESCRIPTION	DATE	APPR.
1	Construction Change Order. Revised Limits of Grouted Rock.	6-25-82	D.W.W.
2	Increased 6' Chain Link Fence.	11-15-82	D.A.
3	Increased 3' Chain Link Fence.	11-15-82	D.A.
4	Changed Toe Section.	10-18-82	D.A.
5	Changed Limits of Toe Section.	10-18-82	D.A.

REFERENCE INFORMATION AND NOTES

DATE 3-1-82
DESIGN G. Kongler
DRAWN G. Signor
CHECKED J. Pandit

Santa Clara Valley Water District

ENGINEERING CERTIFICATION — PROJECT ENGINEER — R.C.E. No. 19214

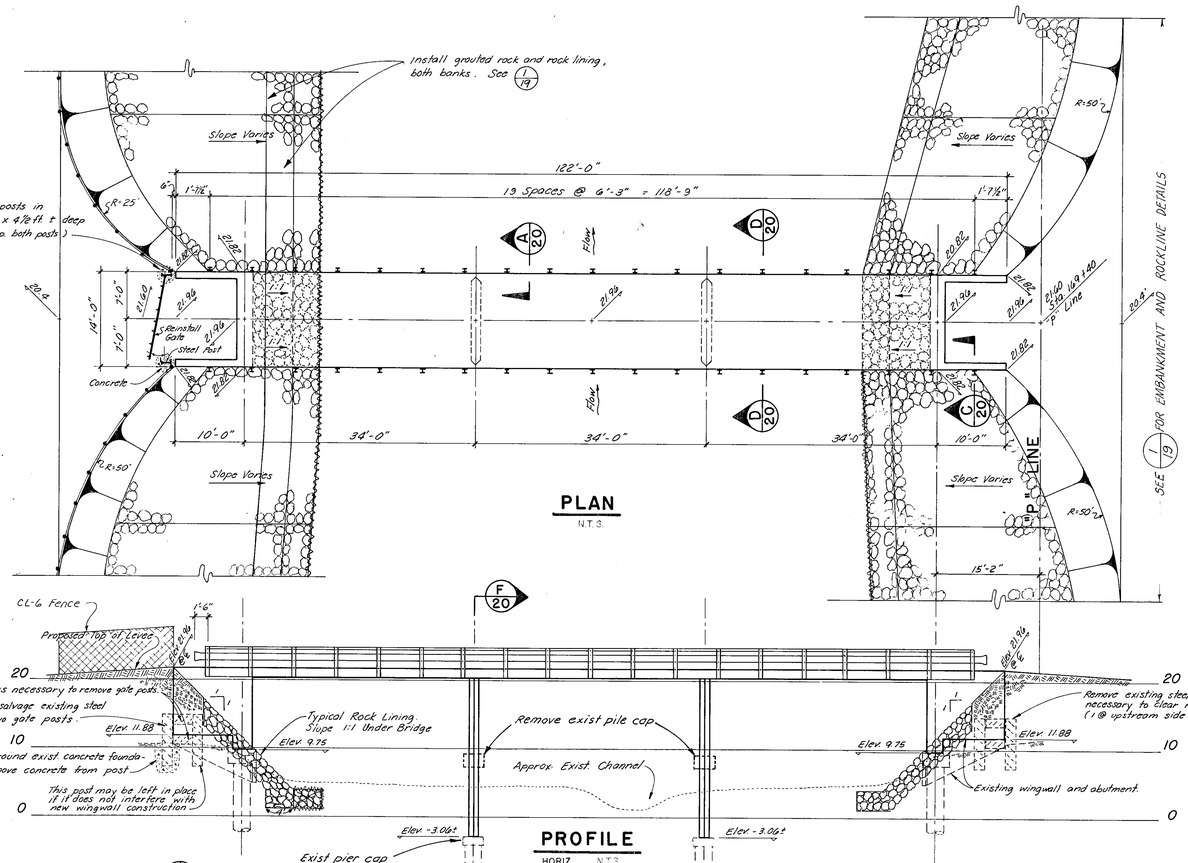
ENGINEERING APPROVAL — DIVISION ENGINEER — R.C.E. No. 18759

STEVENS CREEK
HWY 101 TO SHORELINE PARK
DETAILS

SCALE AS SHOWN

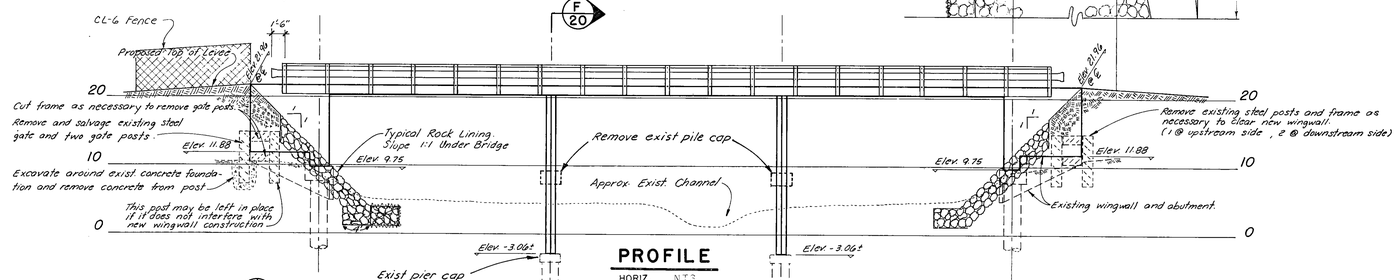
SHEET 19 OF 45

11852



PLAN

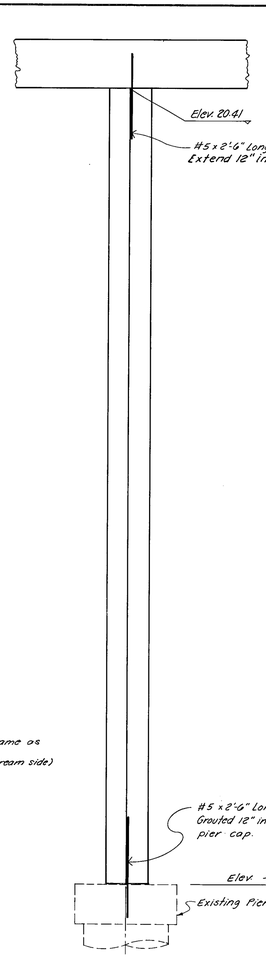
N.T.S.



PROFILE

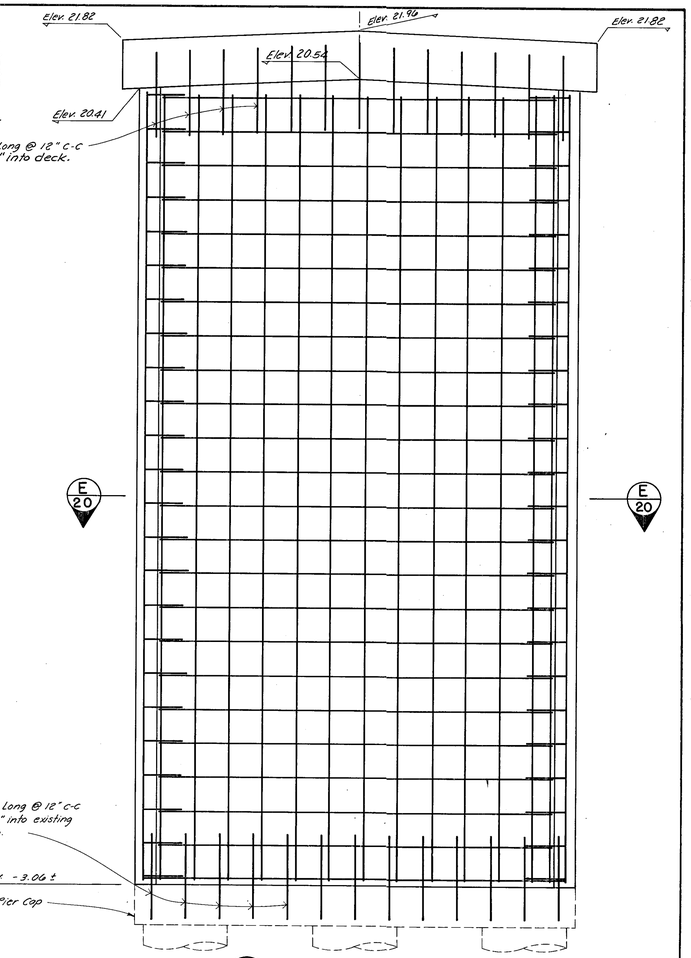
HORIZ. N.T.S.
VERT. 1" = 10'

1/20 CRITTENDEN LANE CONCRETE BRIDGE



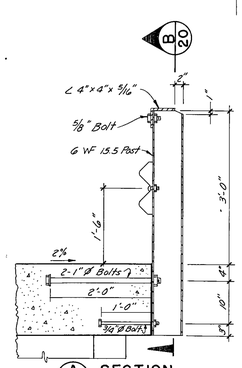
PIER END ELEVATION

SCALE 1/2" = 1'-0"



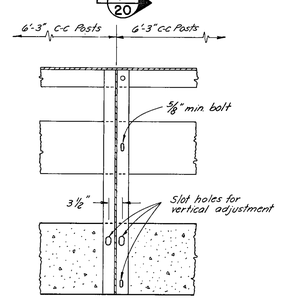
F/20 PIER ELEVATION

SCALE 1/2" = 1'-0"



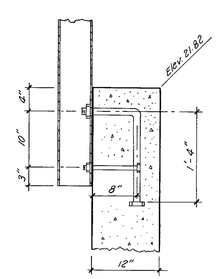
A/20 SECTION

SCALE 3/4" = 1'-0"



B/20 SECTION

SCALE 3/4" = 1'-0"

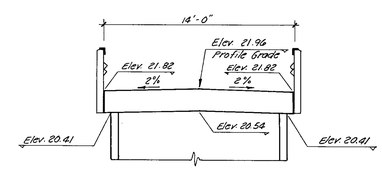


RAIL POST CONNECTION AT WINGWALL

C/20 SECTION

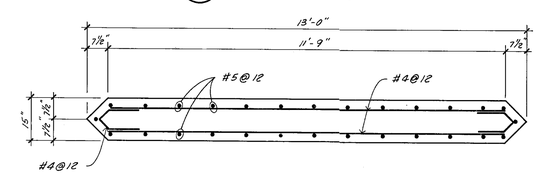
SCALE 1" = 1'-0"

RAILING DETAILS



D/20 TYPICAL BRIDGE SECTION

SCALE 1" = 5'



E/20 SECTION

SCALE 1/2" = 1'-0"

PIER DETAILS

Dean Arroyo
3/22/83

SANTA CLARA_CA Work Maps
SANTA CLARA_CA0592

REV.	DESCRIPTION	DATE	APPR.
1	Modified Toe Section	10-18-82	D.A.

REFERENCE INFORMATION AND NOTES
1. FOR REINFORCEMENT, SEE 1/21

DRAWN AND DESIGNED BY:
BISSELL & KARN, INC.
CIVIL ENGINEERS
100 N. MILPITAS BLVD., MILPITAS, CALIF. 95035
(415) 263-7615

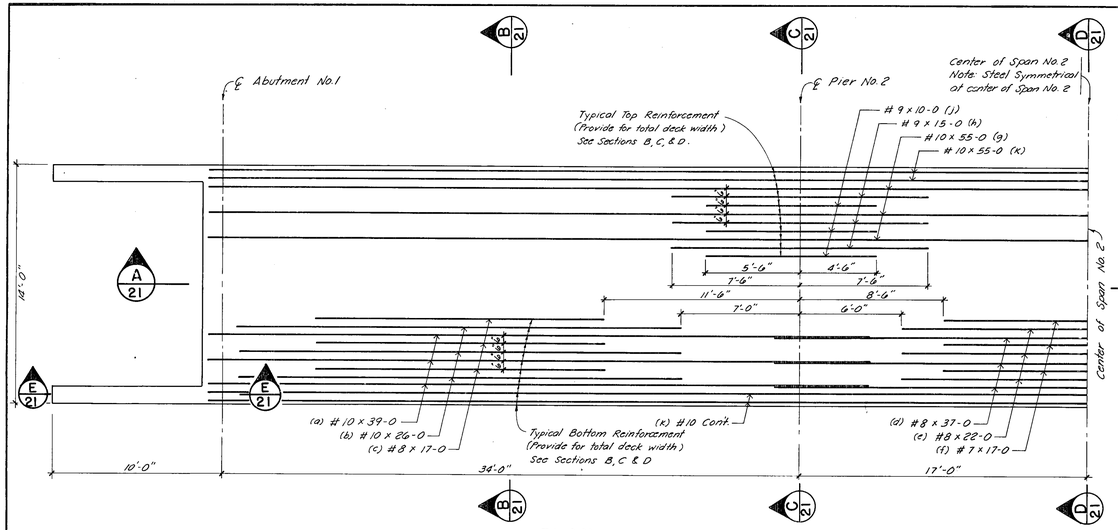
ENGINEERING APPROVAL FOR BISSELL & KARN, INC.
Robert J. Crossett
ROBERT J. CROSSETT RCE NO. 10879
JOB NO. 7440
FILE NO. F-1439

Santa Clara Valley Water District
ACCEPTED BY DISTRICT 3-1-82
David W. McNutt
DESIGN DIVISION ENGINEER RCE NO. 18759

STEVENS CREEK
HWY. 101 TO SHORELINE PARK
DETAILS

SCALE AS SHOWN
SHEET 20 OF 45

11853

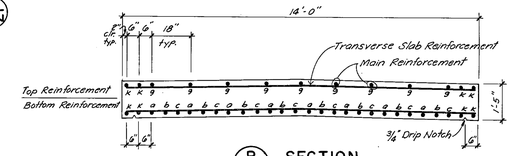


PLAN
PART DECK REINFORCEMENT

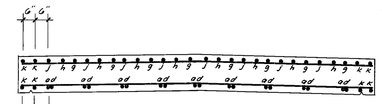
SCALE 1/4" = 1'-0"

LONGITUDINAL STEEL ONLY SHOWN THIS VIEW
SEE PART SECTION FOR TRANSVERSE STEEL

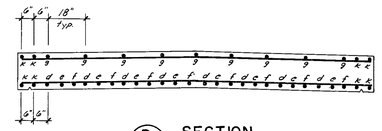
NOTE
1. All steel bars clear 2" unless otherwise specified.



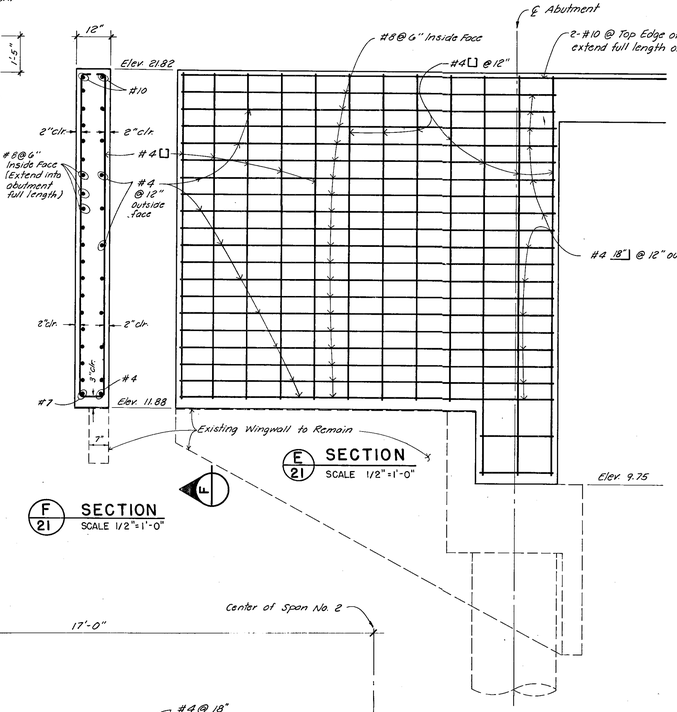
B/21 SECTION
SCALE 3/8" = 1'-0"



C/21 SECTION
SCALE 3/8" = 1'-0"

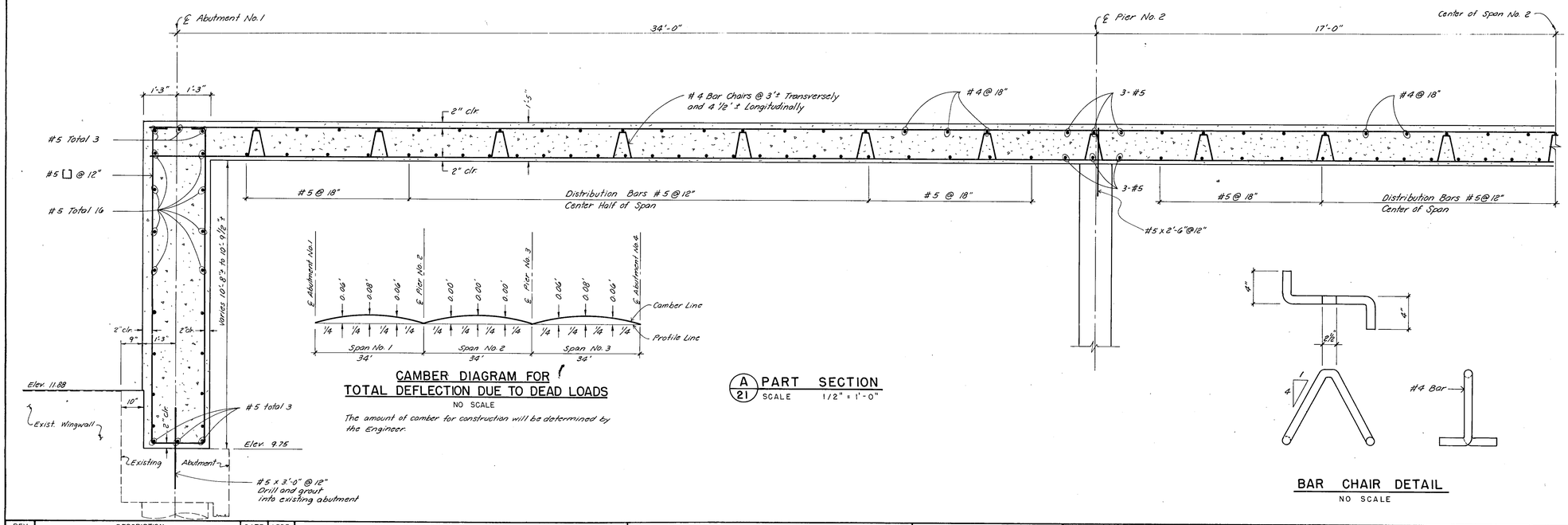


D/21 SECTION
SCALE 3/8" = 1'-0"



E/21 SECTION
SCALE 1/2" = 1'-0"

F/21 SECTION
SCALE 1/2" = 1'-0"



CAMBER DIAGRAM FOR TOTAL DEFLECTION DUE TO DEAD LOADS

NO SCALE

The amount of camber for construction will be determined by the Engineer.

A/21 PART SECTION
SCALE 1/2" = 1'-0"

BAR CHAIR DETAIL

NO SCALE

Dean Arroyo
2/22/83

SANTA CLARA_CA Work Maps
SANTA CLARA_CA0593

REV.	DESCRIPTION	DATE	APPR.	REFERENCE INFORMATION AND NOTES

DRAWN AND DESIGNED BY:
BISSELL & KARN, INC.
CIVIL ENGINEERS
100 N. MILPITAS BLVD., MILPITAS, CALIF. 95035
(415) 263-7615

ENGINEERING APPROVAL FOR BISSELL & KARN, INC.
Robert J. Crossett
ROBERT J. CROSSETT RCE NO. 10879

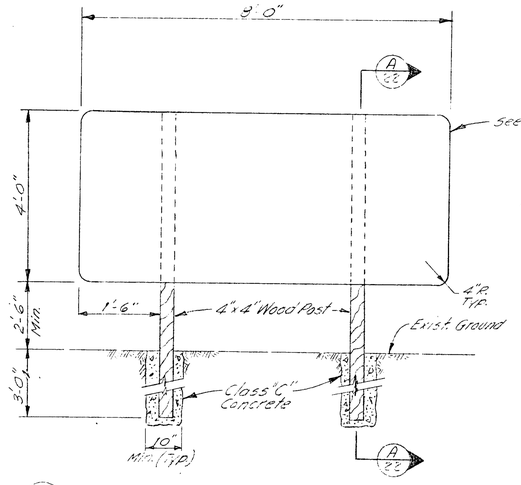
JOB NO. 7440
FILE NO. F-1439

Santa Clara Valley Water District
ACCEPTED BY DISTRICT 3-1-82
David M. McHale
DESIGN DIVISION ENGINEER RCE NO. 18759

STEVENS CREEK
HWY 101 TO SHORELINE PARK
DETAILS

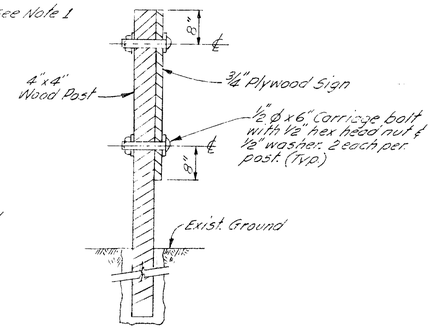
SCALE AS SHOWN
SHEET 21 OF 45

11854

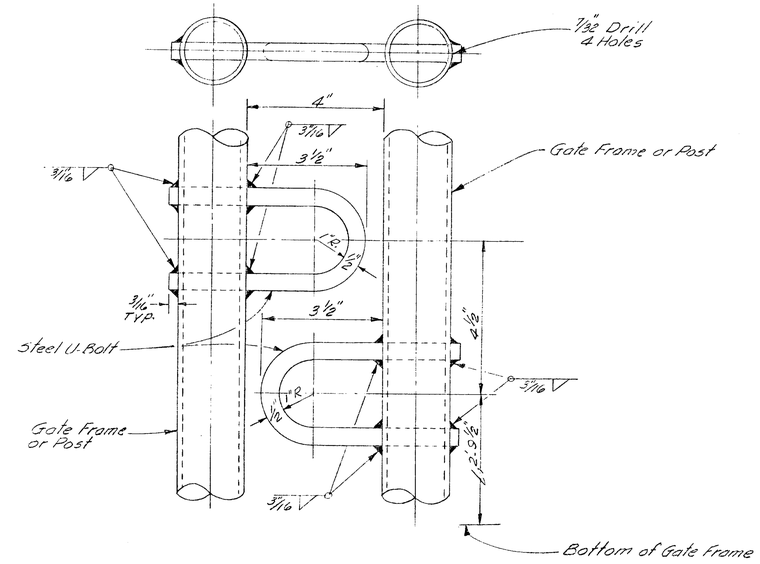


1/22 PROJECT SIGN INSTALLATION

N.T.S.

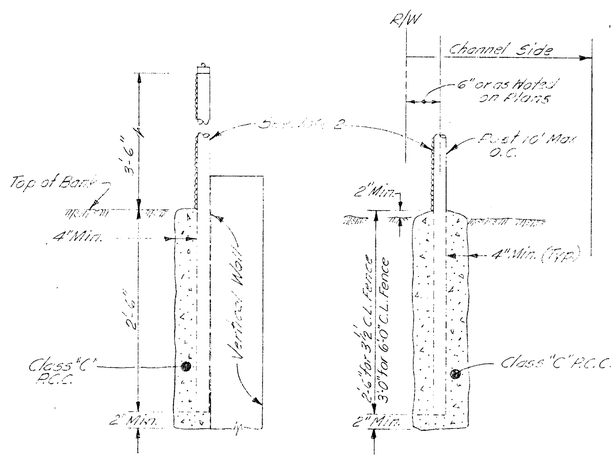


A/22 SIGN BOLTING



5/22 CL GATE LOCKING MECHANISM

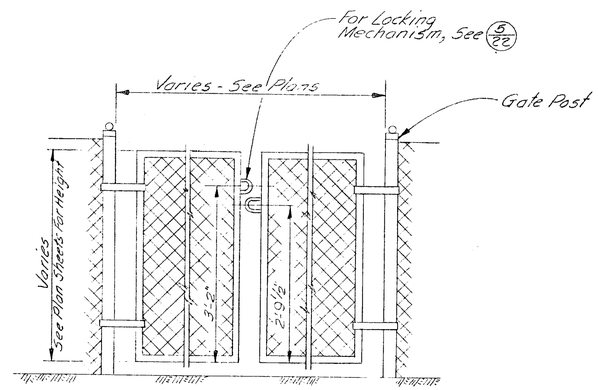
N.T.S.



DETAIL 2/22 N.T.S.

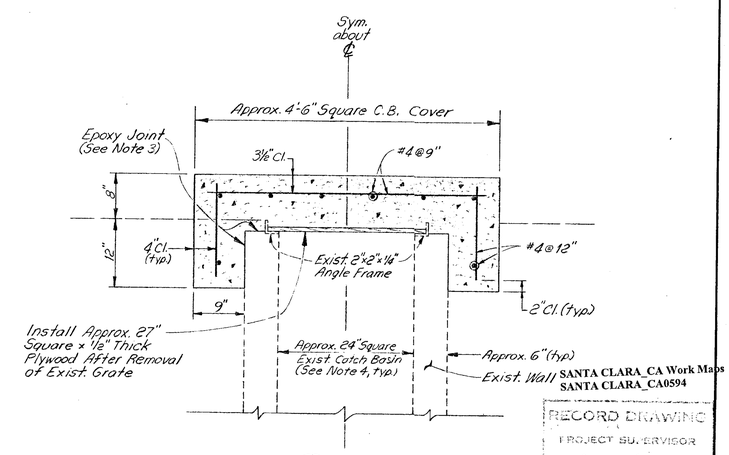
DETAIL 3/22 N.T.S.

TYPICAL CHAIN LINK FENCE INSTALLATION



4/22 CL DOUBLE SWING DOUBLE DRIVE GATE

N.T.S.



DETAIL 6/22 CATCH BASIN COVER

Scale: 1" = 1'-0"

SANTA CLARA_CA Work Maps
SANTA CLARA_CA0594

RECORD DRAWING
PROJECT SUPERVISOR
BY Dean Crosp
DATE 2/22/83

REV.	DESCRIPTION	DATE	APPR.

REFERENCE INFORMATION AND NOTES

1. Project Signs to be provided by the District shall be transported to the job site and installed as shown on the plans by the Contractor. Exact locations of signs shall be directed by the Engineer.
2. C.L. Fence shall be provided as shown on the plans.
3. Clean all contact surfaces and apply epoxy resin. No crack or openings will be permitted between the new and exist. concrete.
4. Dimensions shown of the exist. manhole are approximate. Exact dimensions are to be determined in the field.

DATE 3-1-82
DESIGN S.L.E.I.
DRAWN G.R. S.W.
CHECKED J. Pandit

Santa Clara Valley Water District

ENGINEERING CERTIFICATION
PROJECT ENGINEER R.C.E. No. 19214

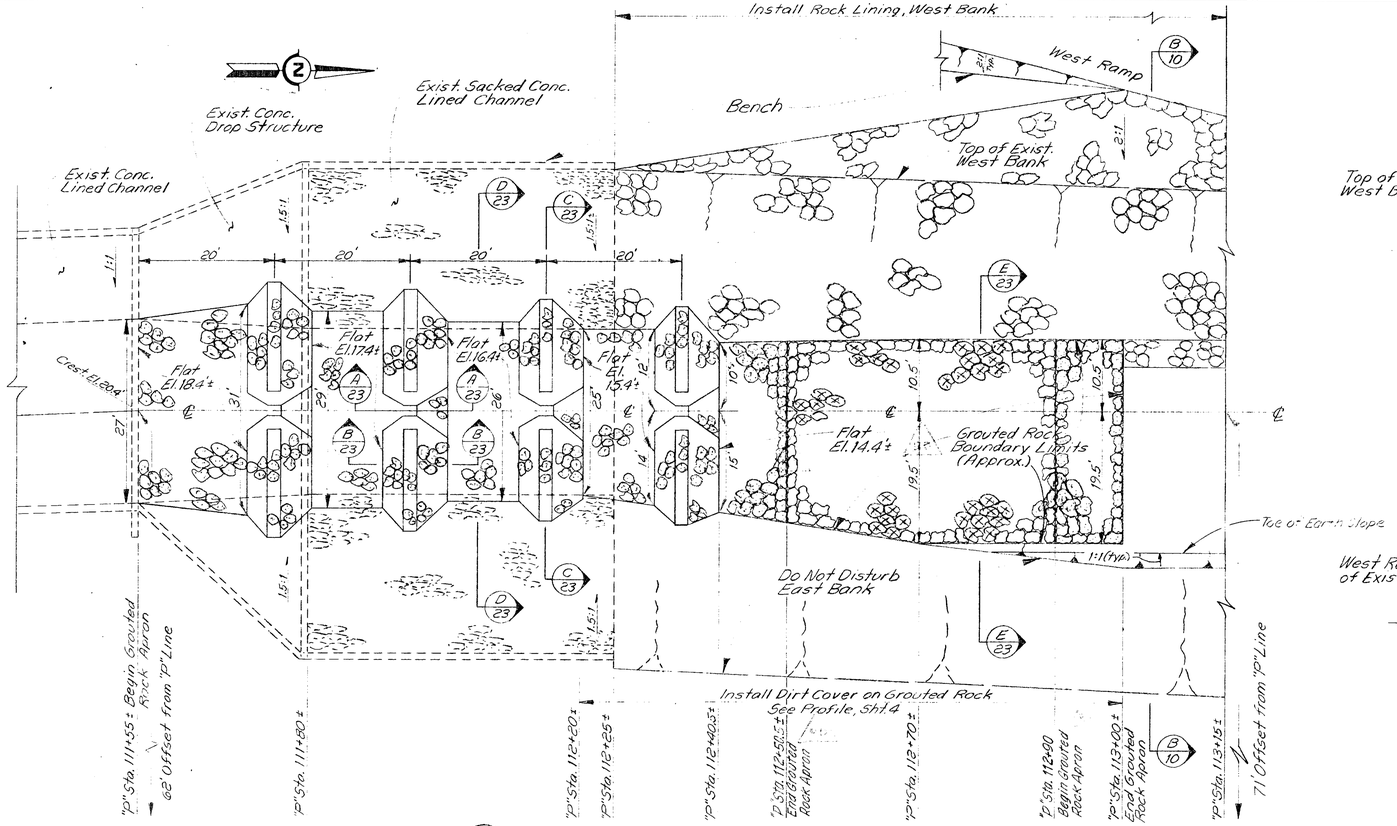
ENGINEERING APPROVAL
DIVISION ENGINEER R.C.E. No. 18759

STEVENS CREEK
HWY 101 TO SHORELINE PARK
DETAILS

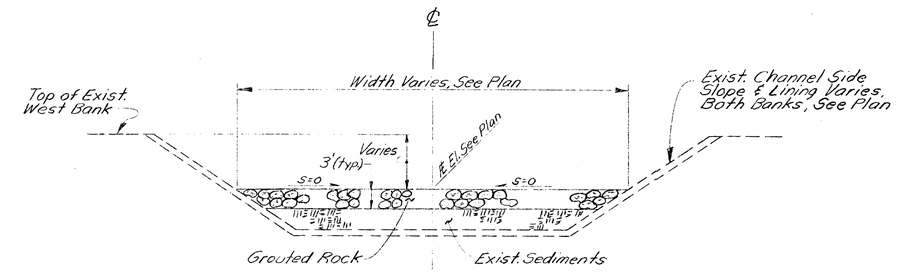
SCALE NOT TO SCALE

SHEET 22 OF 45

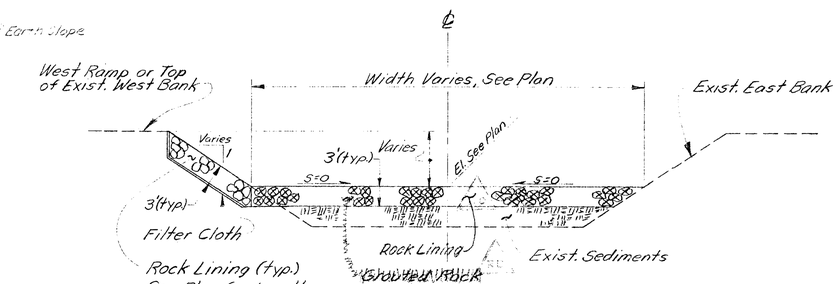
11855



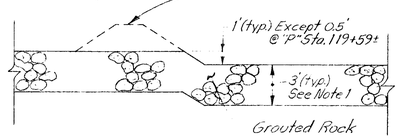
DETAIL 1/23 PLAN-GROUTED ROCK APRON
Scale: 1"=10'



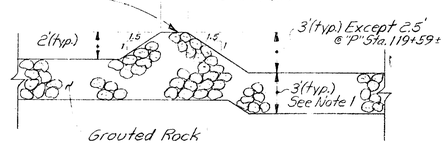
SECTION D/23
Scale: 1"=10'



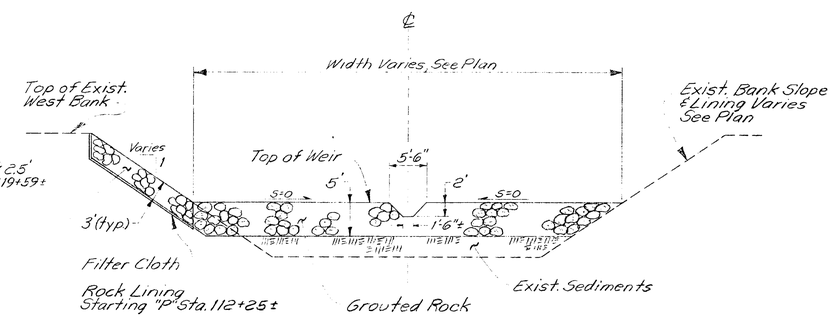
SECTION E/23
Scale: 1"=10'



SECTION A/23
Scale: 1"=5'



SECTION B/23
Scale: 1"=5'



SECTION C/23
Scale: 1"=10'

RECORD DRAWING
PROJECT SUPERVISOR
BY Dean Arroyo
DATE 2/23/83

SANTA CLARA_CA Work Maps
SANTA CLARA_CA0595

REV.	DESCRIPTION	DATE	APPR.
1	Construction Change Order. Revised Limits of Grouted Rock.	6-25-82	D.M.W.

REFERENCE INFORMATION AND NOTES
1. The thickness of grouted rock may vary due to interference from existing lining See profile, Sheet 4.

DATE 3-1-82
DESIGN S.LEI
DRAWN G.R.S. S.W.
CHECKED J.Pandit

Santa Clara Valley Water District

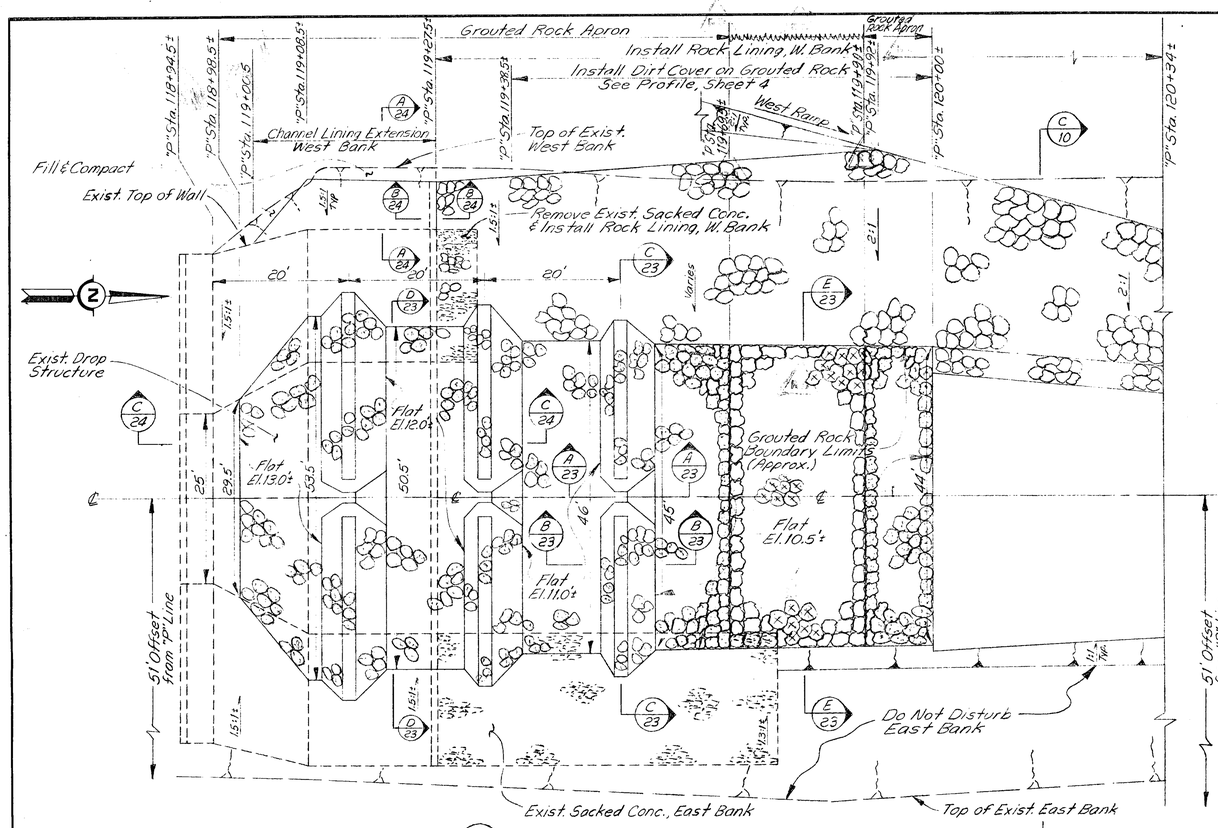
ENGINEERING CERTIFICATION
PROJECT ENGINEER R.C.E. No. 19214

ENGINEERING APPROVAL
DIVISION ENGINEER R.C.E. No. 18759

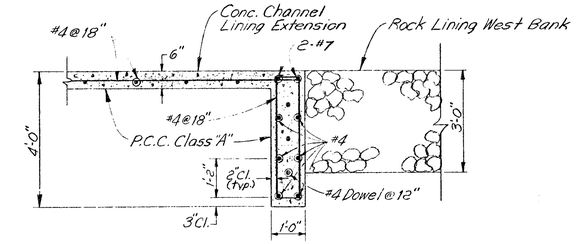
STEVENS CREEK
HWY 101 TO SHORELINE PARK
DETAILS

SCALE As Shown
SHEET 23 OF 45

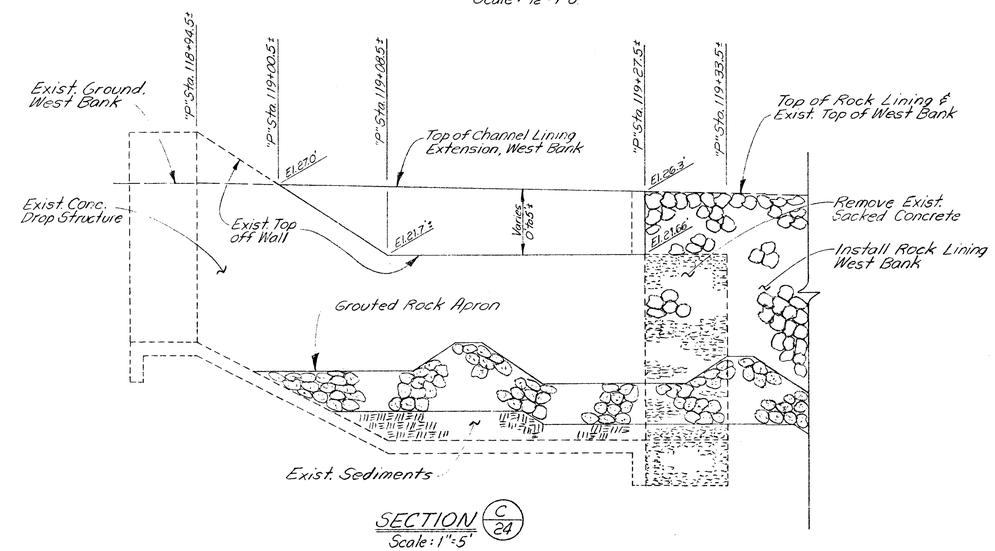
11856



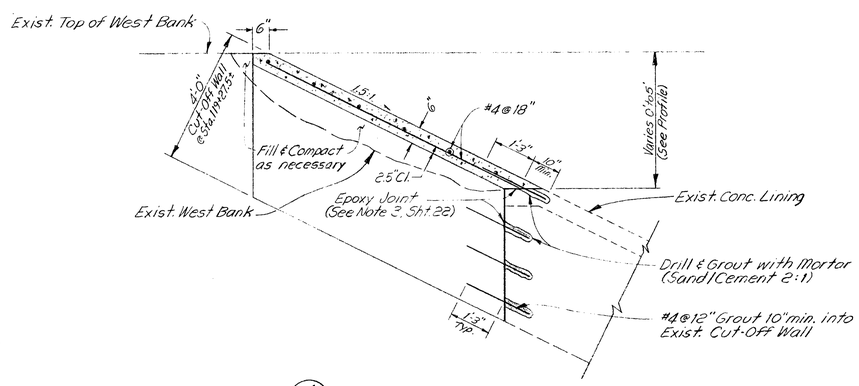
DETAIL 1/24 PLAN - GROUTED ROCK APRON
Scale: 1"=10'



SECTION B/24 CUT-OFF WALL
Scale: 1/2"=1'-0"



SECTION C/24
Scale: 1"=5'



DETAIL A/24 CHANNEL LINING EXTENSION
Scale: 1/2"=1'-0"

SANTA CLARA_CA Work Maps
SANTA CLARA_CA0596

PLANNED DRAWING
UNDER SUPERVISION
BY Dean Arrigo
DATE 2/22/83

REV.	DESCRIPTION	DATE	APPR.
1	Construction Change Order. Revised Limits of Grouted Rock.	6-25-82	DM.W.

REFERENCE INFORMATION AND NOTES

DATE 3-1-82
DESIGN S.LEI
DRAWN S.W.
CHECKED J. Pandit

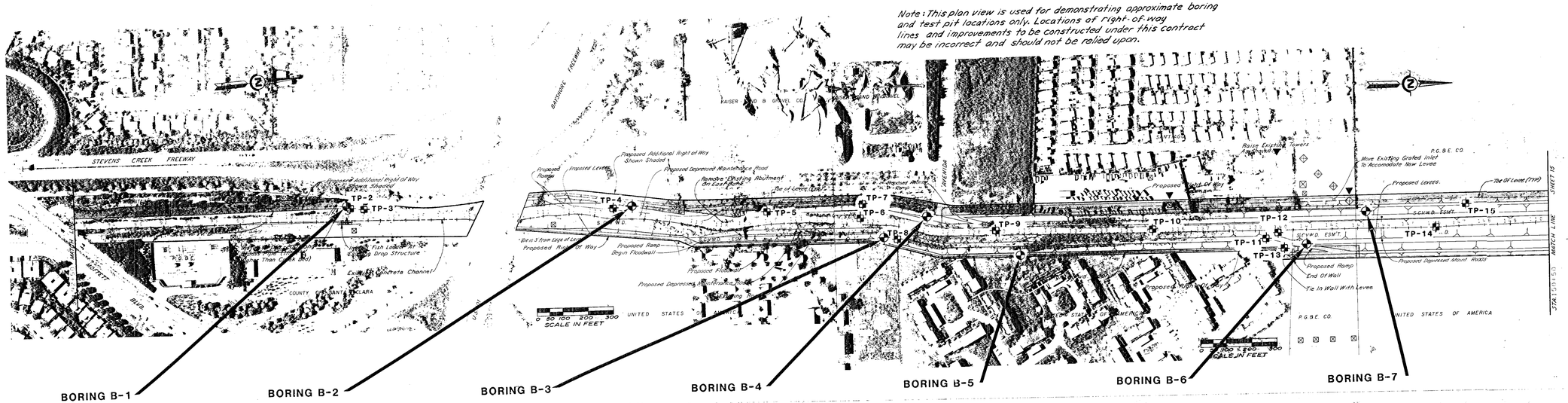
Santa Clara Valley Water District

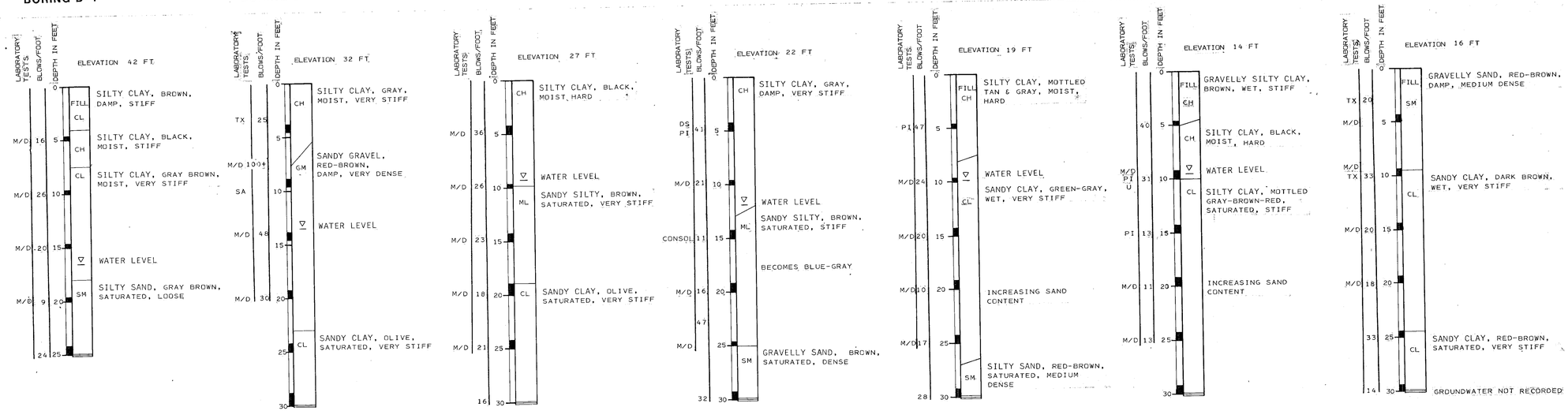
ENGINEERING CERTIFICATION — PROJECT ENGINEER — R.C.E. No. 19214
ENGINEERING APPROVAL — DIVISION ENGINEER — R.C.E. No. 18759

STEVENS CREEK
HWY 101 TO SHORELINE PARK
DETAILS

SCALE As Shown
SHEET 24 OF 45

11857





BORING LOCATION

TEST PIT LOCATION

RECORD DRAWING
PROJECT SUPERVISOR
BY: Dean Arroyo
DATE: 3/22/83

SANTA CLARA_CA Work Maps
SANTA CLARA_CA0597

BY: LDL/BR

JOB NUMBER: 915-40

REV.	DESCRIPTION	DATE	APPR

REFERENCE INFORMATION AND NOTES

1. UNIFIED SOIL CLASSIFICATION SYSTEM IS EXPLAINED ON PLATE 5 OF THE SOILS REPORT.
2. KEY TO BORING LOGS AND LABORATORY TESTS ARE EXPLAINED ON PLATE 6 OF THE SOILS REPORT.
3. BORING ELEVATIONS ESTIMATED BY INTERPOLATING BETWEEN GROUND ELEVATIONS SHOWN ON THE PROJECT PROFILE PLAN.

SOIL INVESTIGATIONS BY
BERLOGAR, LONG & ASSOC.
2468 EMBARCADERO WAY
PALO ALTO, CALIF. 94303

DATE 7/81
DESIGN
DRAWN
CHECKED J.P.

Santa Clara Valley Water District

ENGINEERING CERTIFICATION — PROJECT ENGINEER — R.C.E. No. 19214

ENGINEERING APPROVAL 3-1-82 — DESIGN ENGINEER — R.C.E. No. 18759

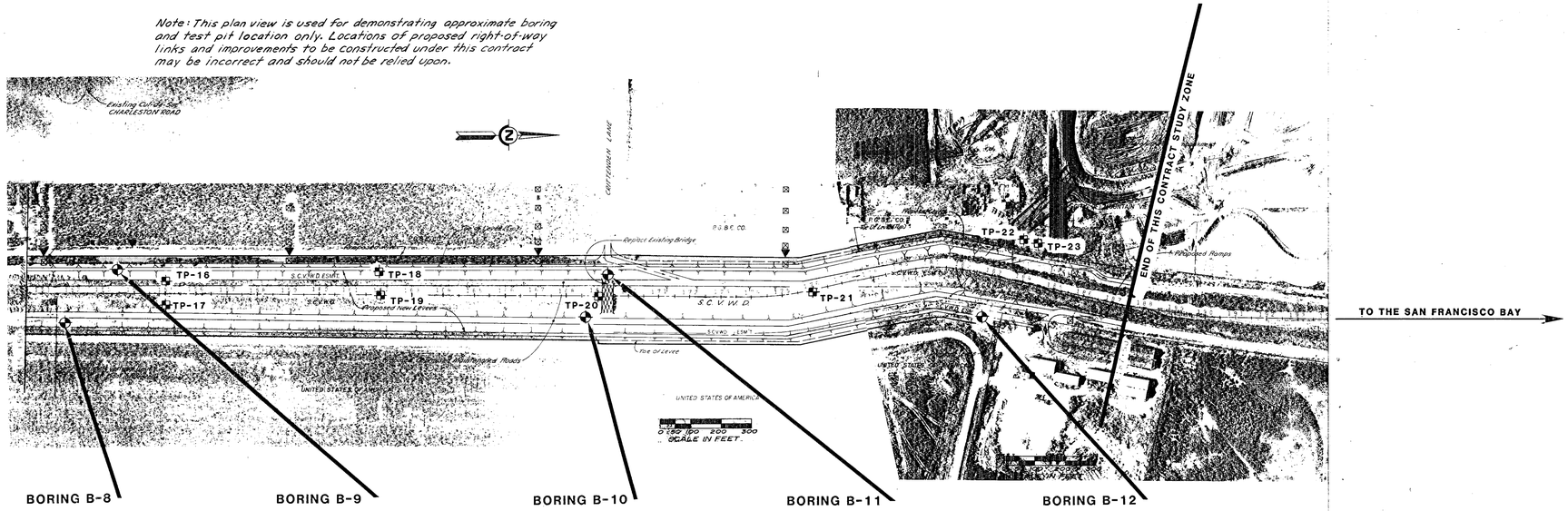
STEVENS CREEK
HWY 101 TO SHORELINE PARK
LOG OF SOIL BORINGS

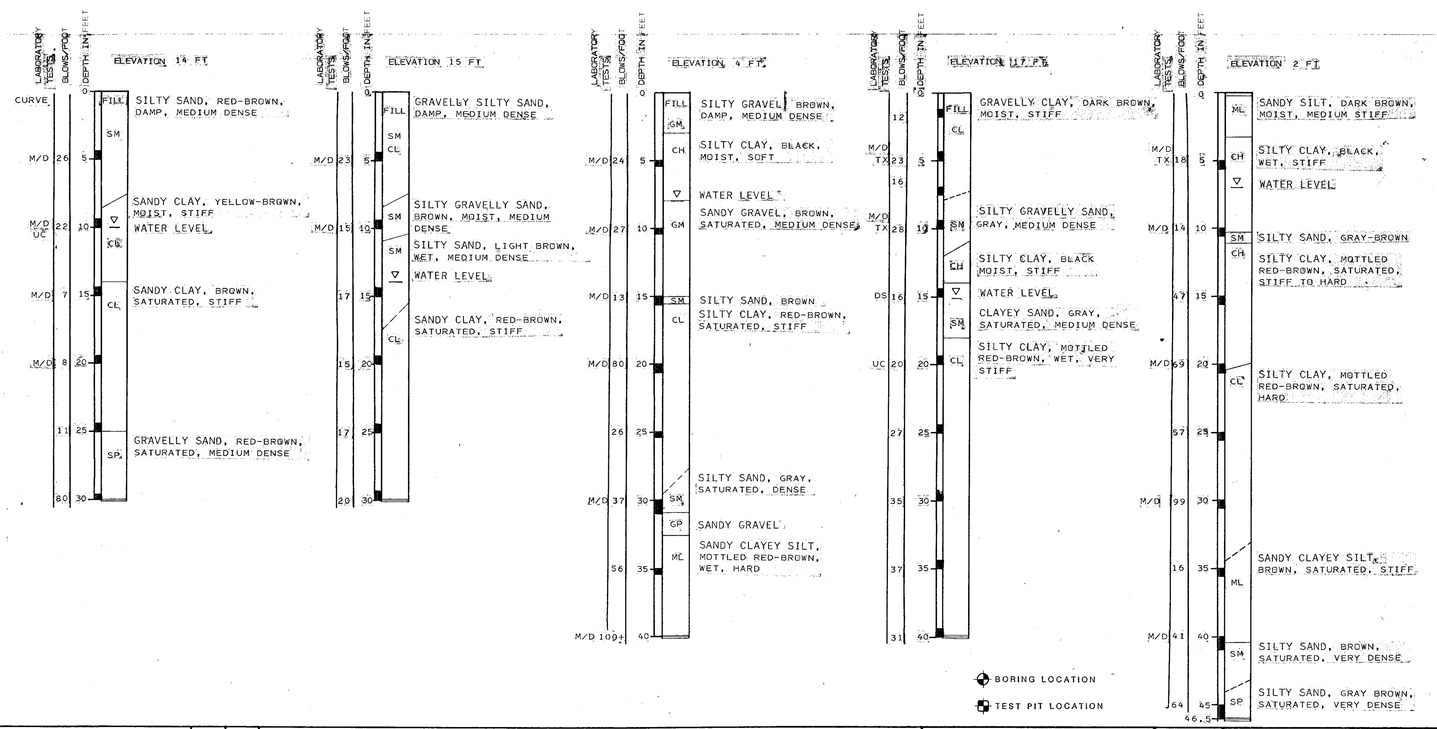
SCALE 1"=200'

SHEET 25 OF 45

11858

Note: This plan view is used for demonstrating approximate boring and test pit location only. Locations of proposed right-of-way links and improvements to be constructed under this contract may be incorrect and should not be relied upon.





RECORD DRAWING
PROJECT SUPERVISOR
BY: Dean Arrigo
DATE: 2/22/83

SANTA CLARA_CA Work Maps
SANTA CLARA_CA0598

BY: LDL/BR

JOB NUMBER: 915-40

REV.	DESCRIPTION	DATE	APPR

REFERENCE INFORMATION AND NOTES

1. UNIFIED SOIL CLASSIFICATION SYSTEM IS EXPLAINED ON PLATE 5 OF THE SOILS REPORT.
2. KEY TO BORING LOGS AND LABORATORY TESTS ARE EXPLAINED ON PLATE 6 OF THE SOILS REPORT.
3. BORING ELEVATIONS ESTIMATED BY INTERPOLATING BETWEEN GROUND ELEVATIONS SHOWN ON THE PROJECT PROFILE PLAN.

SOIL INVESTIGATIONS BY
BERLOGAR, LONG & ASSOC.
2488 EMBARCADERO WAY
PALO ALTO, CALIF. 94303

DATE 7/81
DESIGN
DRAWN
CHECKED J.P.

Santa Clara Valley Water District

ENGINEERING CERTIFICATION — PROJECT ENGINEER — R.C.E. No. 19214

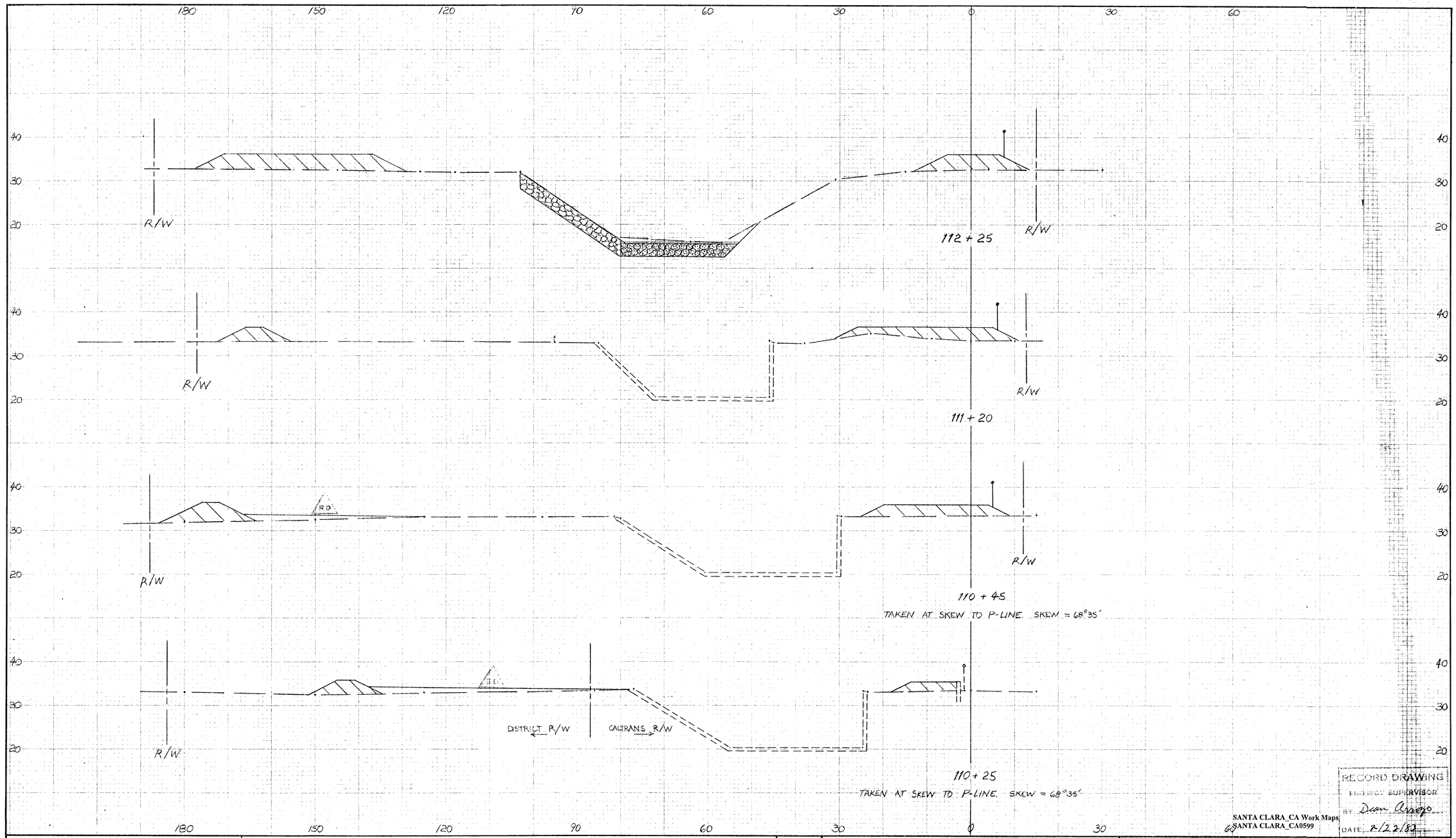
ENGINEERING APPROVAL 3-1-82 — DIVISION ENGINEER — R.C.E. No. 18759

STEVENS CREEK
HWY 101 TO SHORELINE PARK
LOG OF SOIL BORINGS

SCALE 1"=200'

SHEET 26 OF 45

11859



RECORD DRAWING
PROJECT SUPERVISOR
BY Dean Arango
DATE 2/22/82

SANTA CLARA_CA Work Maps
SANTA CLARA_CA0599

REFER TO TRACING FOR LATEST REVISION			
REV.	DESCRIPTION	SUB.	APPR.
1	Graded to Drain Towards Creek.	6-4-82	D.A.

REFERENCE INFORMATION AND NOTES

Pay Limit for Channel Embankment.

DATE 3-1-82
DESIGN Leil Fowler
DRAWN G.R.S.
CHECKED J. Pandit

Santa Clara Valley Water District

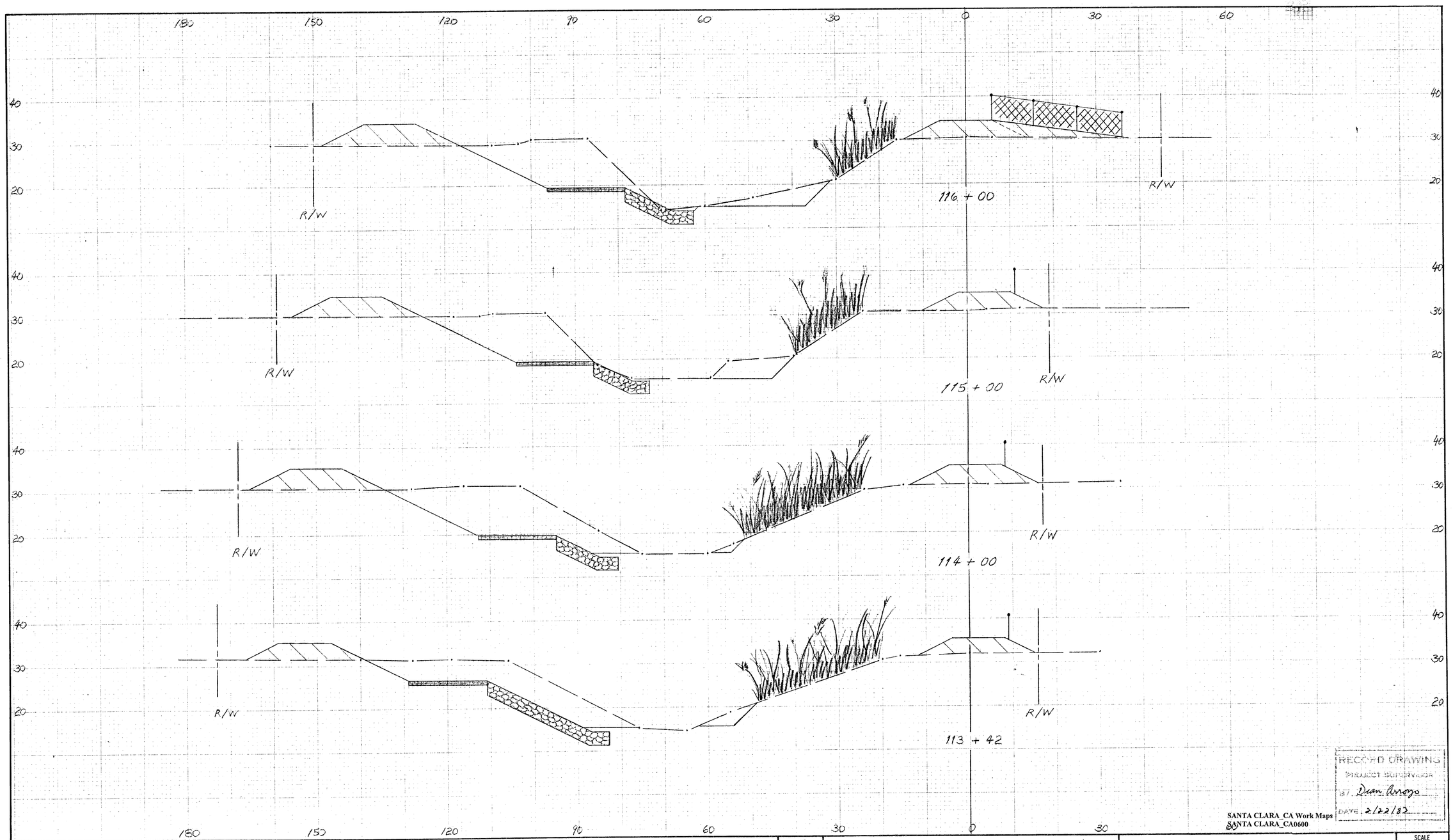
ENGINEERING CERTIFICATION
PROJECT ENGINEER R.C.E. No. 19214
DIVISION ENGINEER R.C.E. No. 18759

STEVENS CREEK
HWY 101 TO SHORELINE PARK
CROSS SECTIONS

SCALE 1" = 10'
SHEET 27 OF 45

1"/860

BRUNSWICK 201-00



RECORD DRAWING
PROJECT SUPERVISOR
BY Dean Arroyo
DATE 2/22/82

SANTA CLARA_CA Work Maps
SANTA CLARA_CA0600

REFER TO TRACING FOR LATEST REVISION			
REV.	DESCRIPTION	SUB.	APPR.

REFERENCE INFORMATION AND NOTES

Pay Limit for Channel Embankment.

DATE	3-1-82
DESIGN	Leiffowler
DRAWN	G.A.S.
CHECKED	J. Pandit

Santa Clara Valley Water District

ENGINEERING CERTIFICATION
PROJECT ENGINEER — R.C.E. No. 19214
DIVISION ENGINEER — R.C.E. No. 18759

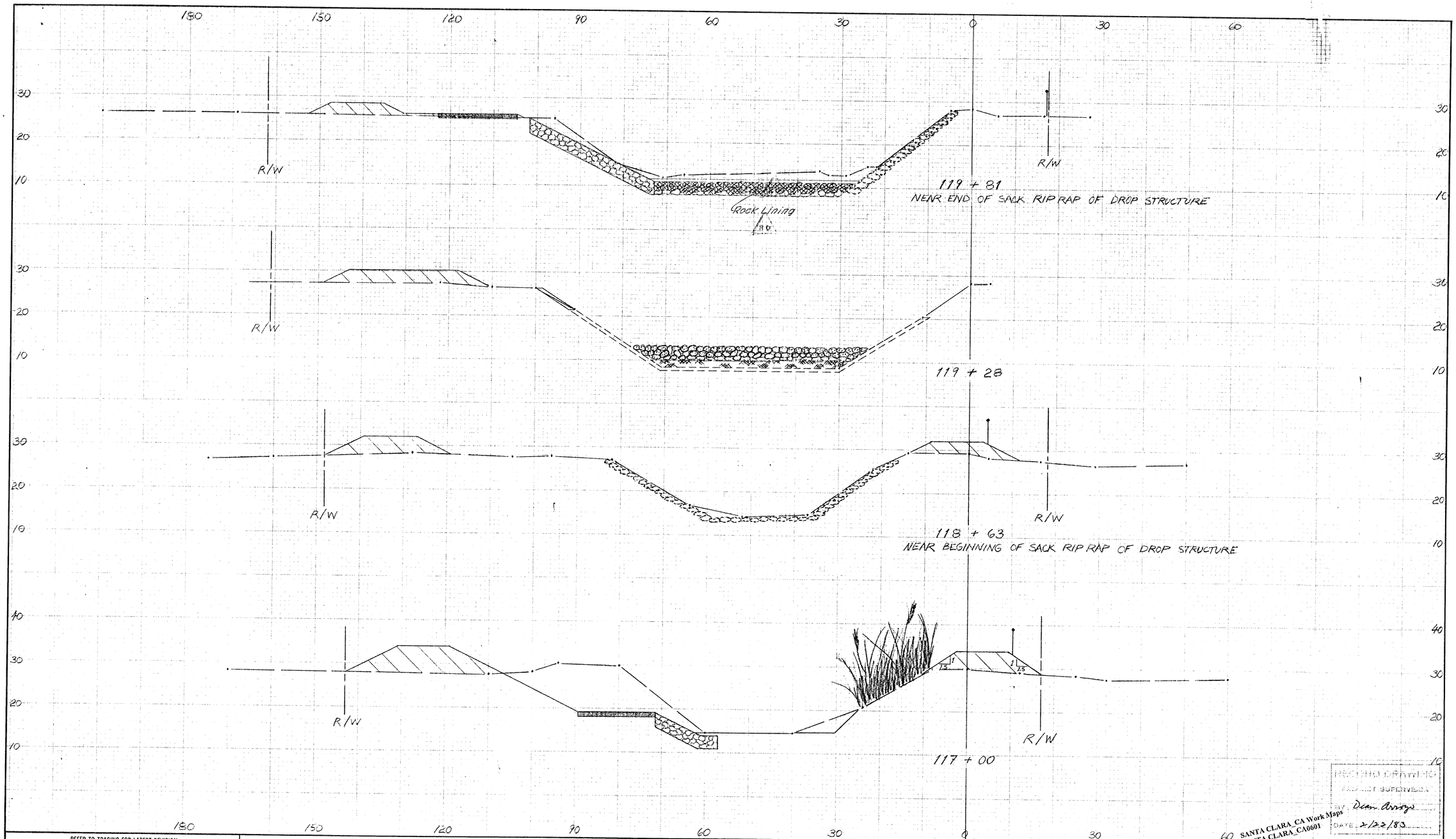
STEVENS CREEK
HWY 101 TO SHORELINE PARK
CROSS SECTIONS

SCALE 1" = 10'

SHEET 28 OF 45

11861

RIGHTWAY 40 OF 45



RECEIVED DRAWINGS
PROJECT SUPERVISOR
BY Dean Arroyo
DATE 2/22/83

REFER TO TRACING FOR LATEST REVISION			
REV.	DESCRIPTION	SUB.	APPR.
1	Construction Change Order. Revised Limits of Grouted Rock.	62582	D.M.H.

REFERENCE INFORMATION AND NOTES

Pay Limit for Channel Embankment

DATE 3-1-82
DESIGN Lei/Fowler
DRAWN G.R.S.
CHECKED J. Pandit

Santa Clara Valley Water District

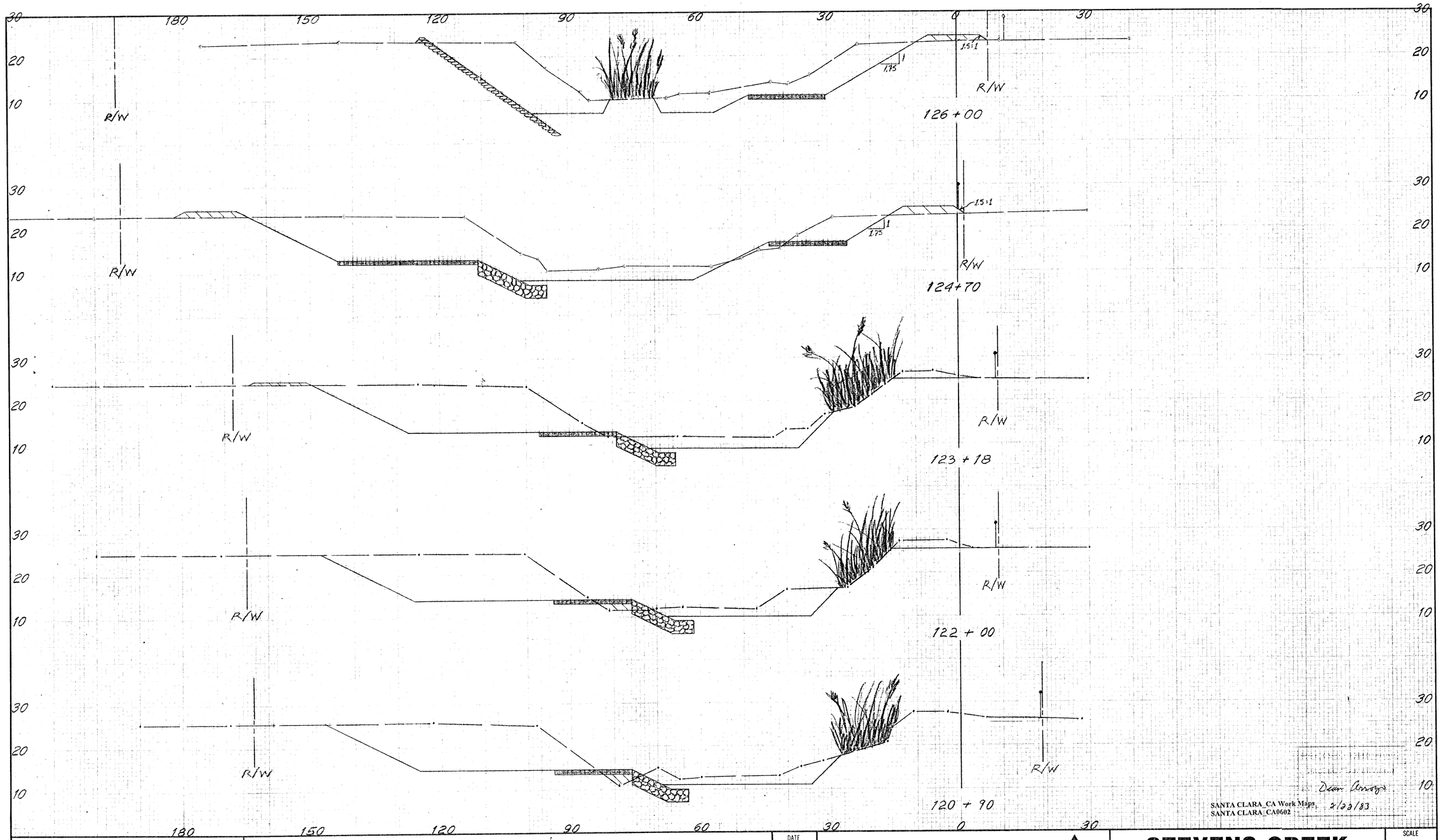
ENGINEERING CERTIFICATION
PROJECT ENGINEER — R.C.E. NO. 19214
DIVISION ENGINEER — R.C.E. No. 18759

STEVENS CREEK
HWY 101 TO SHORELINE PARK
CROSS SECTIONS

SCALE 1" = 10'

SHEET 29 OF 45

11862



SANTA CLARA_CA Work Maps
SANTA CLARA_CA0602

Dean Amaya 2/22/83

REFER TO TRACING FOR LATEST REVISION			
REV.	DESCRIPTION	SUB.	APPR.

REFERENCE INFORMATION AND NOTES

Pay Limit for Channel Embankment

DATE 3-1-82
DESIGN Lei/Fowler
DRAWN F.S.W.
CHECKED J. Pandit

Santa Clara Valley Water District

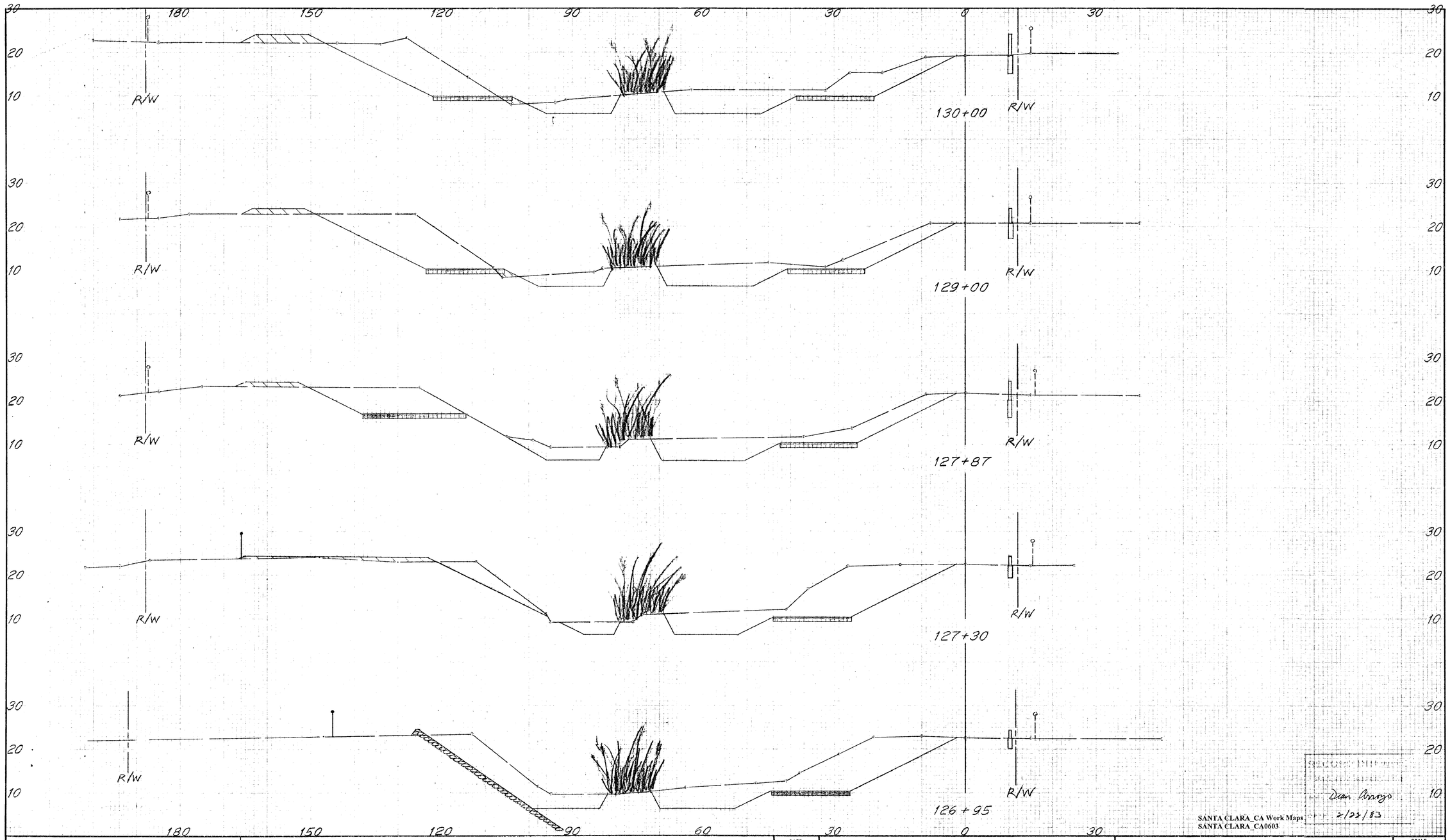
ENGINEERING CERTIFICATION
PROJECT ENGINEER R.C.E. NO. 19214
DIVISION ENGINEER R.C.E. No. 18759

STEVENS CREEK
HWY 101 TO SHORELINE PARK
CROSS SECTIONS

SCALE 1" = 10'

SHEET 30 OF 45

11863



REFER TO TRACING FOR LATEST REVISION

REV.	DESCRIPTION	SUB.	APPR.

REFERENCE INFORMATION AND NOTES

Pay Limit for Channel Embankment.

DATE 3-1-82
DESIGN Lei/Fowler
DRAWN F.S.W.
CHECKED J. Pandit

ENGINEERING CERTIFICATION
PROJECT ENGINEER R.C.E. NO. 19214
DIVISION ENGINEER R.C.E. No. 18759

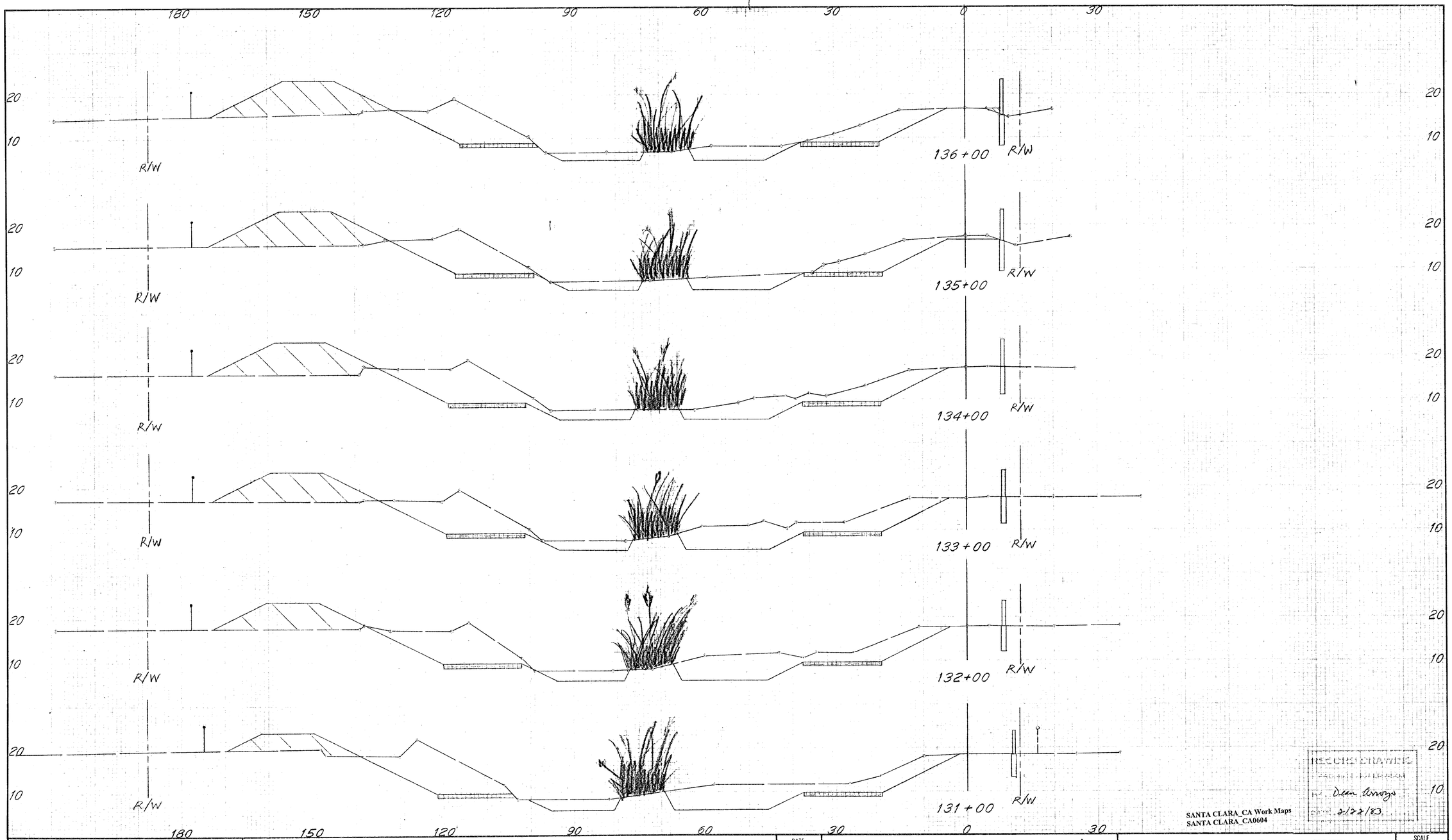
Santa Clara Valley Water District

STEVENS CREEK
HWY 101 TO SHORELINE PARK
CROSS SECTIONS

SCALE 1" = 10'

SHEET 31 OF 45

11864



SANTA CLARA_CA Work Maps
SANTA CLARA_CA0604

RECORD DRAWING
Dean Arroyo
3/22/83

REFER TO TRACING FOR LATEST REVISION			
REV.	DESCRIPTION	SUB.	APPR.

REFERENCE INFORMATION AND NOTES

Pay Limit for Channel Embankment.

DATE 3-1-82
DESIGN Lei/Fowler
DRAWN F.S.W.
CHECKED J. Pandit

Santa Clara Valley Water District

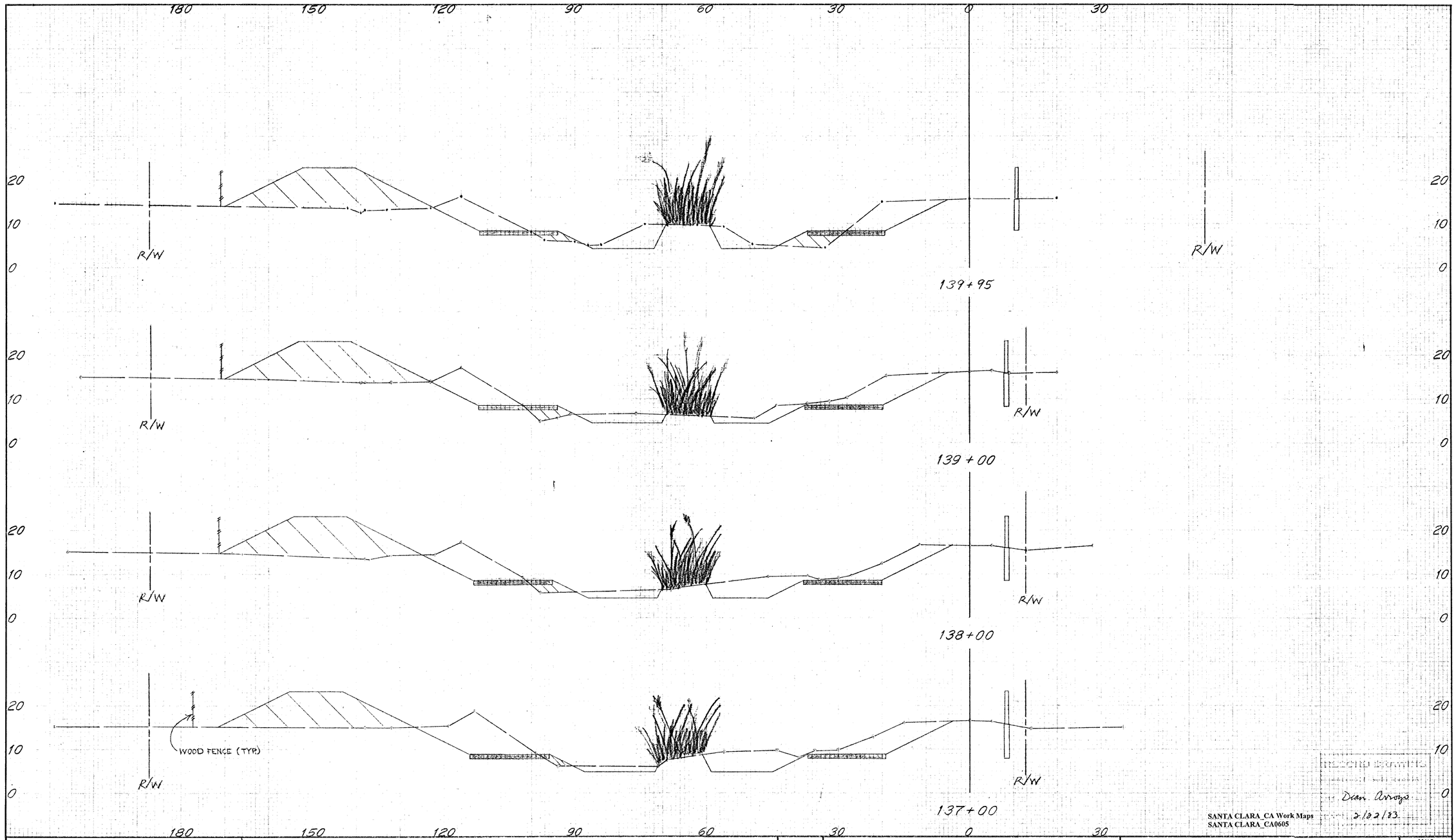
ENGINEERING CERTIFICATION
PROJECT ENGINEER R.C.E. NO. 19214
DIVISION ENGINEER R.C.E. No. 18759

STEVENS CREEK
HWY 101 TO SHORELINE PARK
CROSS SECTIONS

SCALE 1" = 10'

SHEET 32 OF 45

11865



SANTA CLARA_CA Work Maps
SANTA CLARA_CA0605

Dian. Arroyo
2/22/83

REFER TO TRACING FOR LATEST REVISION			
REV.	DESCRIPTION	SUB.	APPR.

REFERENCE INFORMATION AND NOTES

Pay Limit for Channel Embankment.

DATE 3-1-82
DESIGN Leif Fowler
DRAWN F.S.W.
CHECKED J. Pandit

Santa Clara Valley Water District

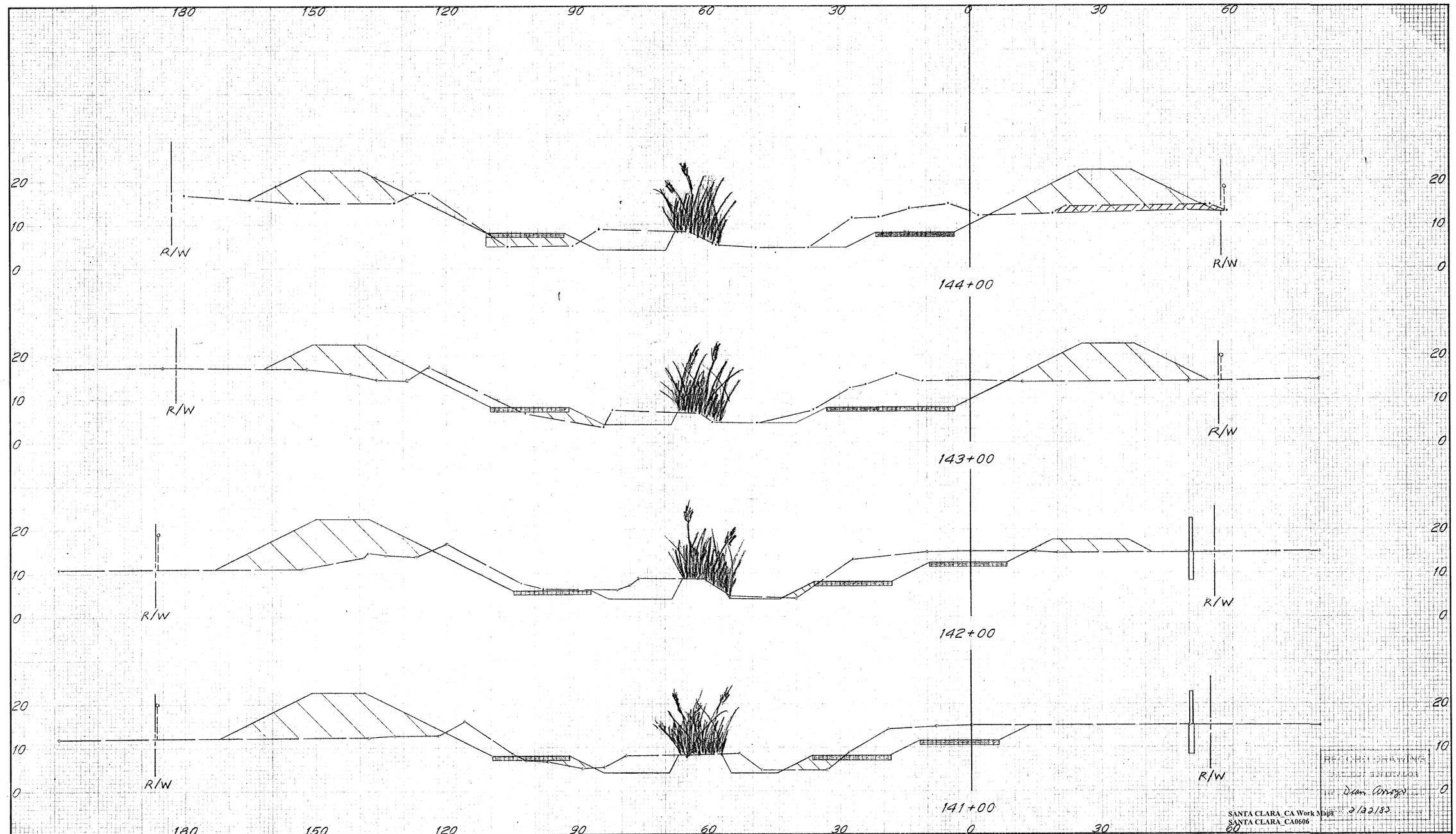
ENGINEERING CERTIFICATION
PROJECT ENGINEER R.C.E. NO. 19214
DIVISION ENGINEER R.C.E. No. 18759

STEVENS CREEK
HWY 101 TO SHORELINE PARK
CROSS SECTIONS

SCALE 1" = 10'

SHEET 33 OF 45

11866



SANTA CLARA_CA Work Maps
SANTA CLARA_CA0606

REFER TO TRACING FOR LATEST REVISION			
REV.	DESCRIPTION	SUB.	APPR.

REFERENCE INFORMATION AND NOTES

Pay Limit for Channel Embankment

Approx Exist Loose Material.

DATE 3-1-82
DESIGN Leif Fowler
DRAWN F.S.W.
CHECKED J. Ponott

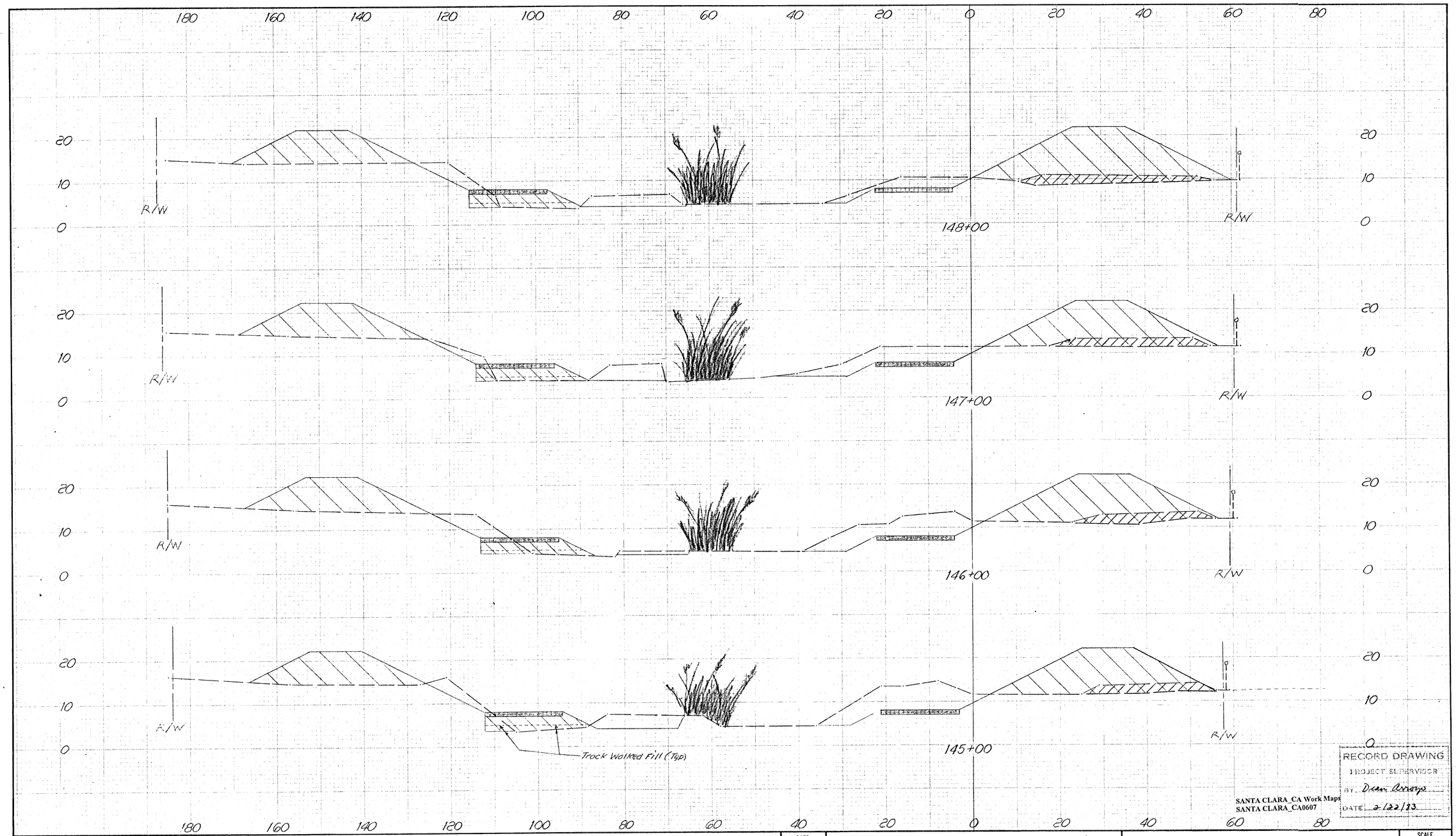
Santa Clara Valley Water District

ENGINEERING CERTIFICATION
PROJECT ENGINEER R.C.E. NO. 19214
DIVISION ENGINEER R.C.E. No. 18759

STEVENS CREEK
HWY 101 TO SHORELINE PARK
CROSS SECTIONS

SCALE 1" = 10'
SHEET 34 OF 45

11867



RECORD DRAWING
PROJECT SUPERVISOR
BY Dean Arroyo
DATE 7/22/83

SANTA CLARA_CA Work Maps
SANTA CLARA_CA0607

REFER TO TRACING FOR LATEST REVISION

REV.	DESCRIPTION	SUB.	APPR.

REFERENCE INFORMATION AND NOTES

Pay Limit for Channel Embankment.

Approx Exist Loose Material.

DATE	3-1-82
DESIGN	Lei/Fowler
DRAWN	S.W.
CHECKED	J. Pandit

Santa Clara Valley Water District

ENGINEERING CERTIFICATION
PROJECT ENGINEER — R.C.E. NO. 19214
DIVISION ENGINEER — R.C.E. No. 18759

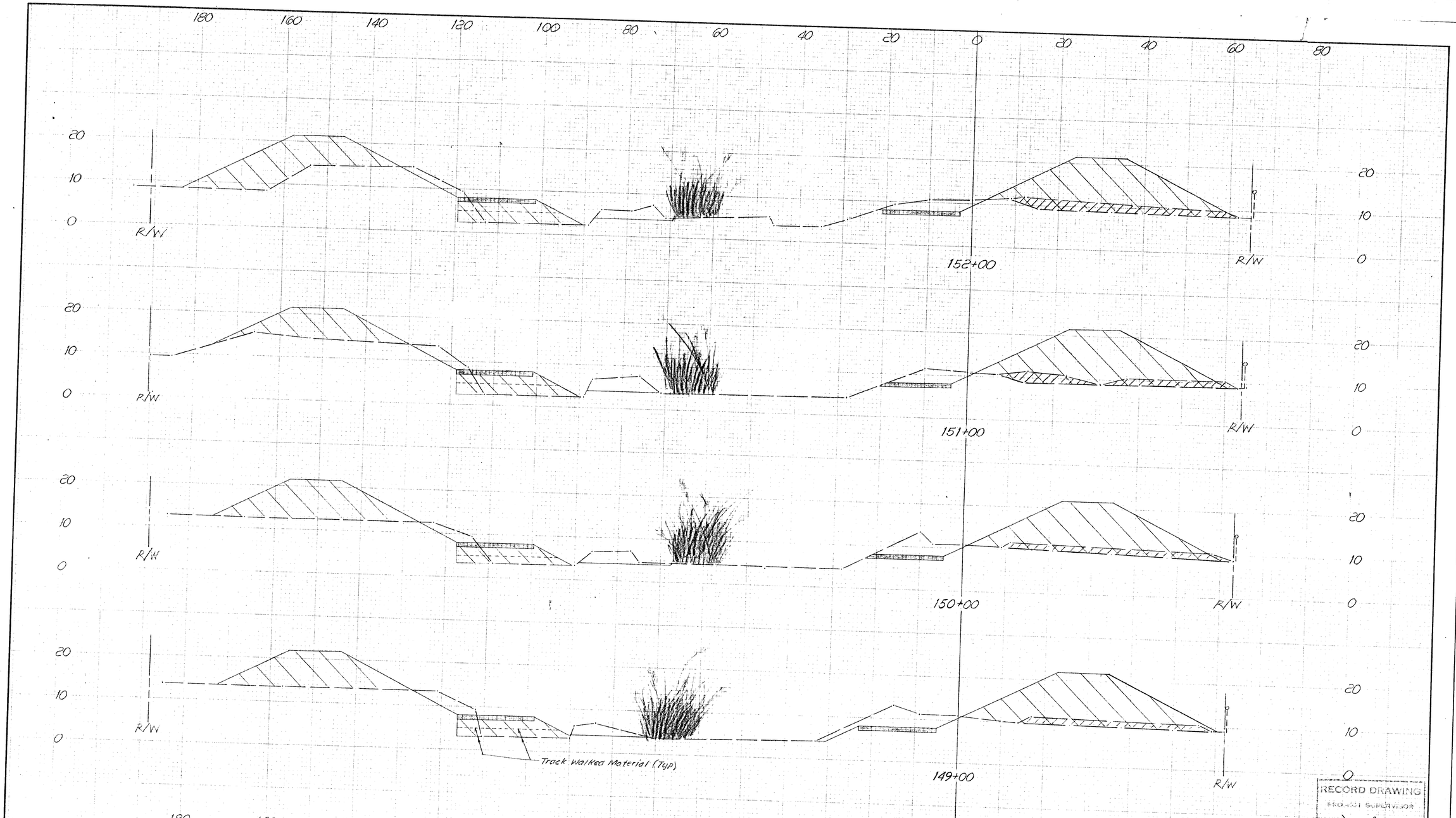
STEVENS CREEK
HWY 101 TO SHORELINE PARK
CROSS SECTIONS

SCALE 1" = 10'

SHEET 35 OF 45

11868

BRUNING 40-102



RECORD DRAWING
PROJECT SUPERVISOR
BY: Dean Arroyo
DATE: 2/22/83

SANTA CLARA_CA Work Maps
SANTA CLARA_CA0608

REFER TO TRACING FOR LATEST REVISION

REV.	DESCRIPTION	SUB.	APPR.

REFERENCE INFORMATION AND NOTES

Pay Limit for Channel Embankment.

Approx Exist Loose Material.

DATE 3-1-83
DESIGN Leif Fowler
DRAWN S.W.
CHECKED J. Pandit

Santa Clara Valley Water District

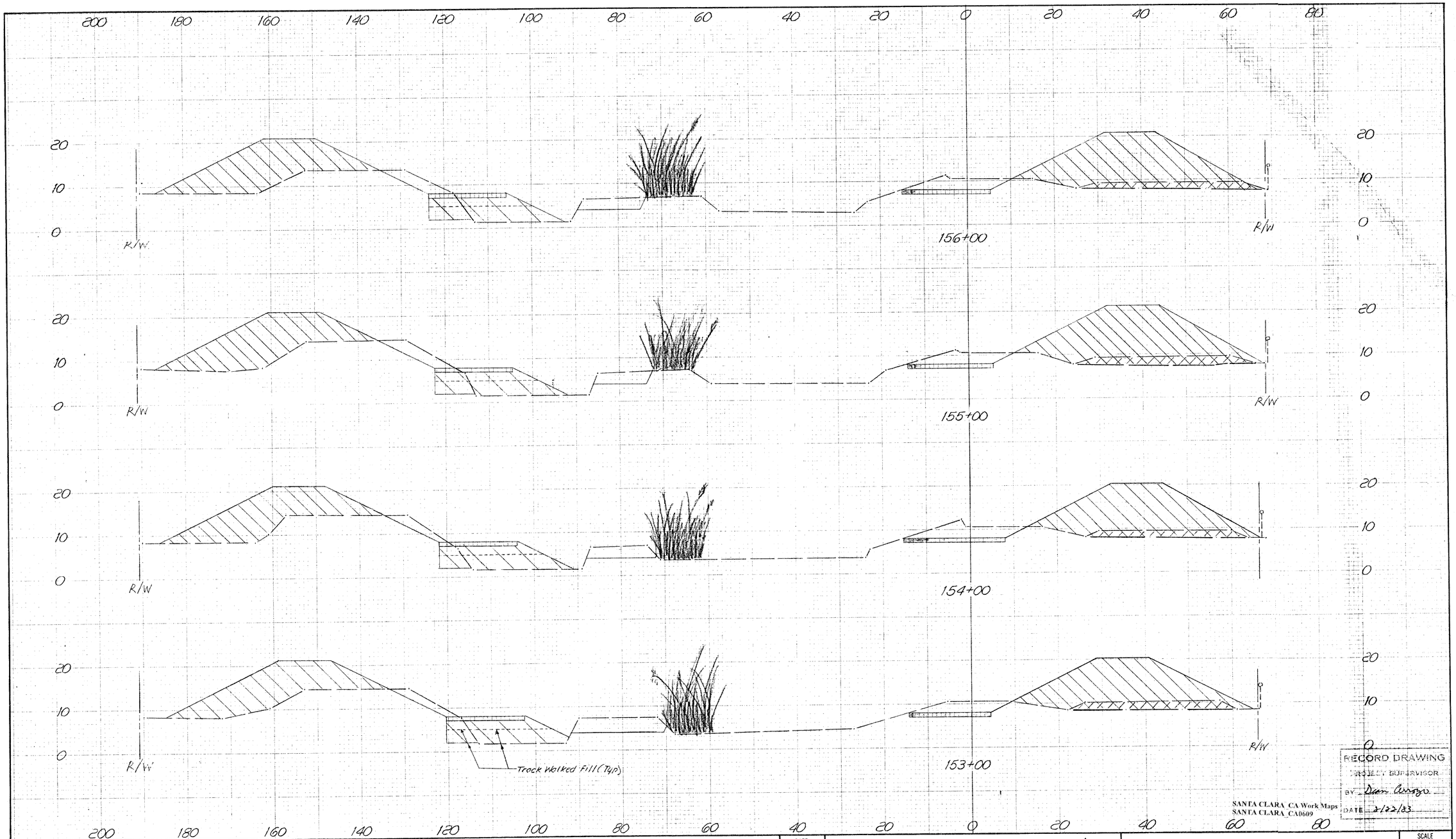
ENGINEERING CERTIFICATION
PROJECT ENGINEER R.C.E. NO. 19214
DIVISION ENGINEER R.C.E. No. 18759

STEVENS CREEK
HWY 101 TO SHORELINE PARK
CROSS SECTIONS

SCALE 1" = 10'

SHEET 36 OF 45

11869



RECORD DRAWING
RESIDENT SUPERVISOR
BY Dan Arrigo
DATE 2/22/83

SANTA CLARA_CA Work Maps
SANTA CLARA_CAD609

REFER TO TRACING FOR LATEST REVISION			
REV.	DESCRIPTION	SUB.	APPR.

REFERENCE INFORMATION AND NOTES

Pay Limit for Channel Embankment.

Approx Exist Loose Material.

DATE 3-1-82
DESIGN Leil Fowler
DRAWN S.W.
CHECKED J. Pandit

Santa Clara Valley Water District

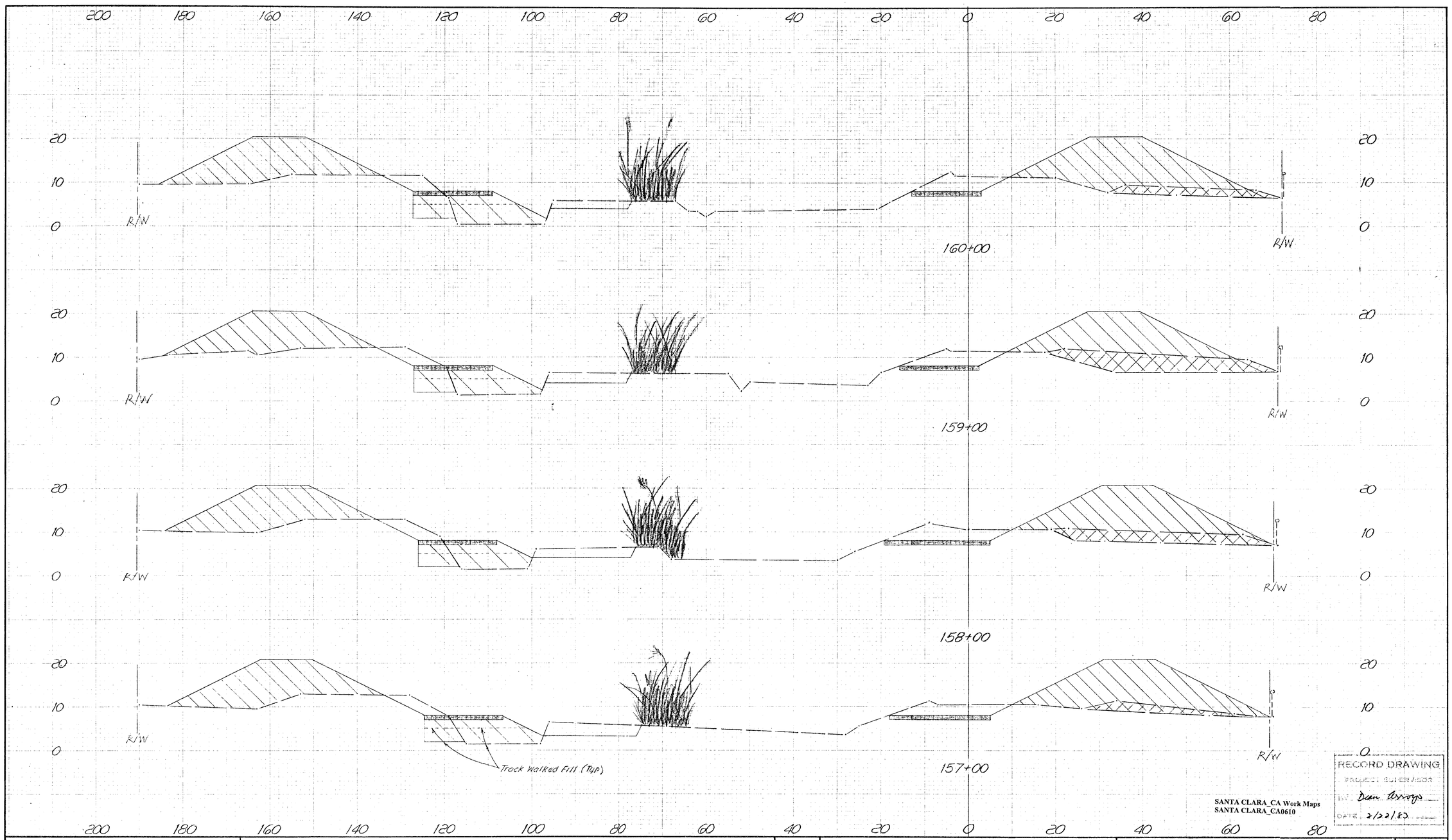
ENGINEERING CERTIFICATION
PROJECT ENGINEER R.C.E. NO. 19314
DIVISION ENGINEER R.C.E. No. 18759

STEVENS CREEK
HWY 101 TO SHORELINE PARK
CROSS SECTIONS

SCALE 1" = 10'

SHEET 37 OF 45

11870



SANTA CLARA_CA Work Maps
SANTA CLARA_CA0610

RECORD DRAWING
PROJECT SUPERVISOR
BY: Dean Lovrovich
DATE: 2/22/83

REFER TO TRACING FOR LATEST REVISION			
REV.	DESCRIPTION	SUB	APPR

REFERENCE INFORMATION AND NOTES

Pay Limit for Channel Embankment.

Approx Exist Loose Material.

DATE 3-1-82
DESIGN Leif Fowler
DRAWN S.W.
CHECKED J. Pandit

Santa Clara Valley Water District

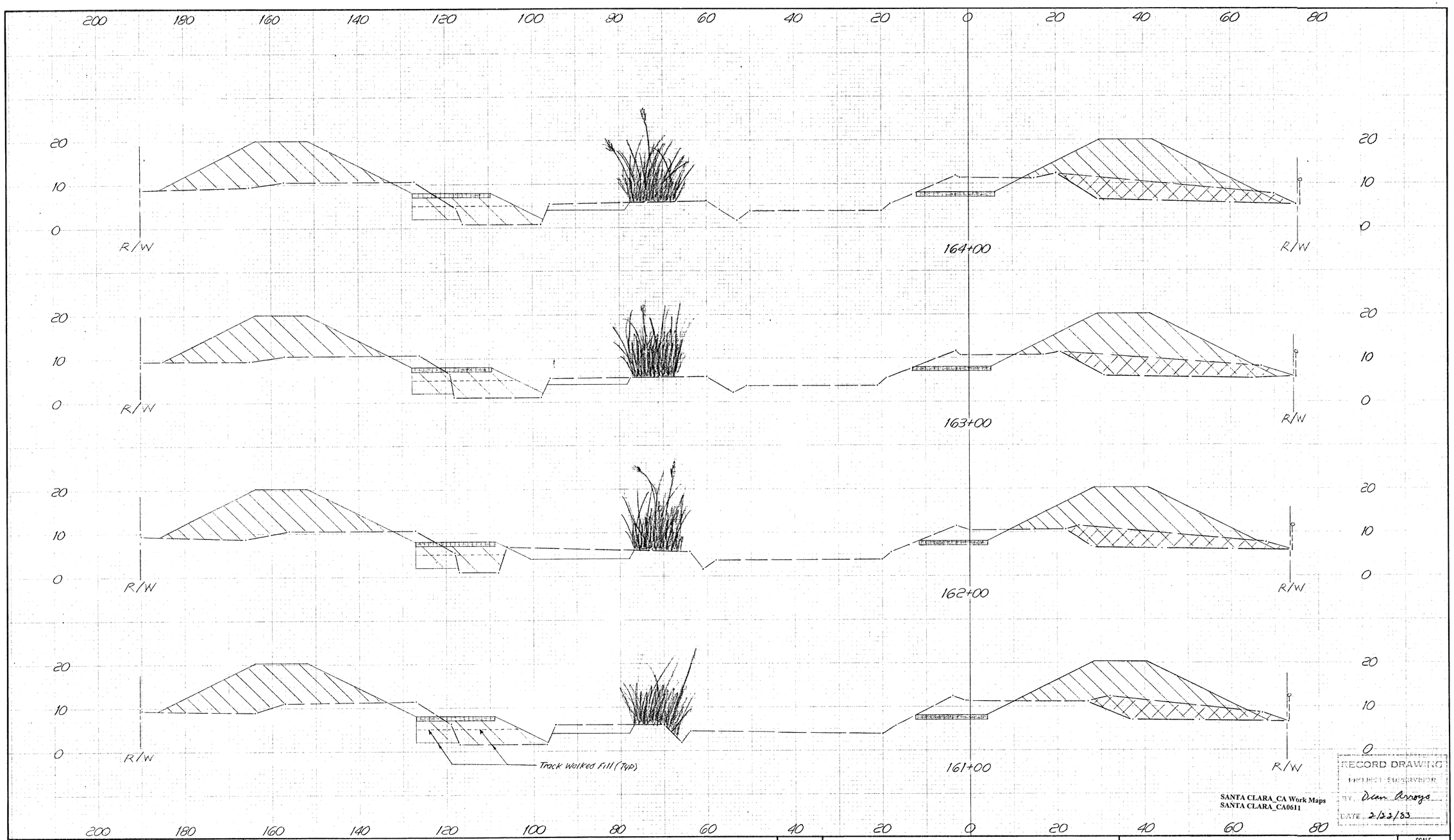
ENGINEERING CERTIFICATION
PROJECT ENGINEER R.C.E. NO. 19214
DIVISION ENGINEER R.C.E. No. 18759

STEVENS CREEK
HWY 101 TO SHORELINE PARK
CROSS SECTIONS

SCALE 1" = 10'
SHEET 38 OF 45

11871

201-DRAWING



SANTA CLARA_CA Work Maps
SANTA CLARA_CA0611

RECORD DRAWING
PROJECT SUPERVISOR
BY Dan Arroyo
DATE 2/22/83

REFER TO TRACING FOR LATEST REVISION			
REV.	DESCRIPTION	SUB.	APPR.

REFERENCE INFORMATION AND NOTES

Pay Limit for Channel Embankment.

Approx Exist Loose Material.

DATE 3-1-82
DESIGN LeilFowler
DRAWN S.W.
CHECKED J.Porlit

Santa Clara Valley Water District

ENGINEERING CERTIFICATION
PROJECT ENGINEER R.C.E. NO. 19214
DIVISION ENGINEER R.C.E. No. 18759

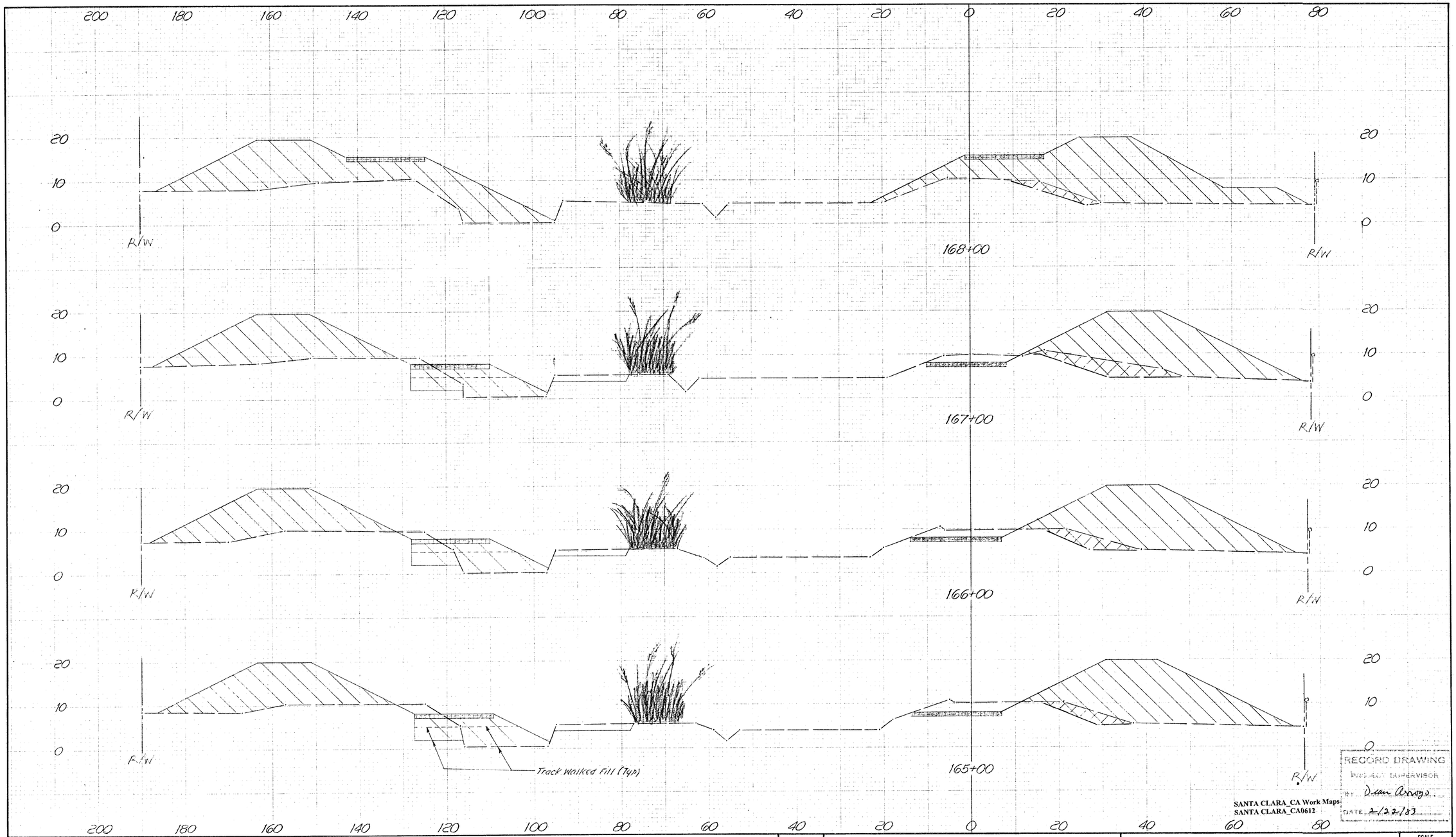
STEVENS CREEK
HWY 101 TO SHORELINE PARK
CROSS SECTIONS

SCALE 1" = 10

SHEET 39 OF 45

11872

BRUNING 4D-102



RECORD DRAWING
PROJECT SUPERVISOR
BY: Dean Arroyo
DATE: 2/22/83

SANTA CLARA_CA Work Maps
SANTA CLARA_CA0612

REFER TO TRACING FOR LATEST REVISION			
REV.	DESCRIPTION	SUB.	APPR.

REFERENCE INFORMATION AND NOTES

Pay Limit for Channel Embankment.

Approx Exist Louse Material.

DATE 3-1-82
DESIGN Lei/Fowler
DRAWN S.W.
CHECKED J.Pandit

Santa Clara Valley Water District

ENGINEERING CERTIFICATION
PROJECT ENGINEER R.C.E. NO. 19214
DIVISION ENGINEER R.C.E. No. 18759

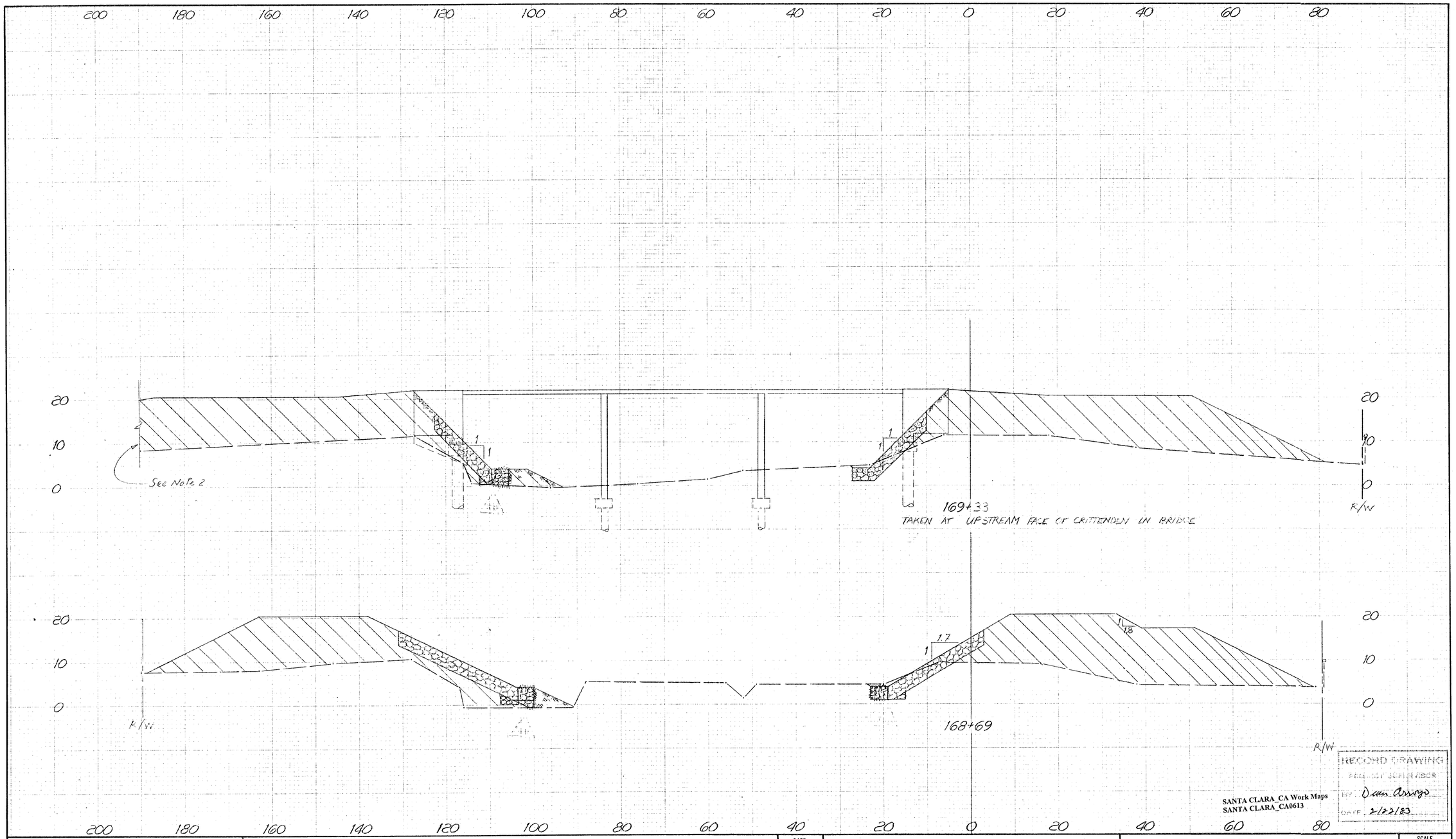
STEVENS CREEK
HWY 101 TO SHORELINE PARK
CROSS SECTIONS

SCALE 1" = 10

SHEET 40 OF 45

11873

BERMUDA 40-102



REFER TO TRACING FOR LATEST REVISION

REV.	DESCRIPTION	SUB.	APPR.
1	Modified Toe Section	10-18-82	D.A.

REFERENCE INFORMATION AND NOTES

Pay Limit for Channel Embankment.

2. Ramp To Crittenden Lane Included in Pay Limit For Channel Embankment.

DATE 3-1-82
DESIGN Leifowler
DRAWN S.W.
CHECKED J. Pandit

Santa Clara Valley Water District

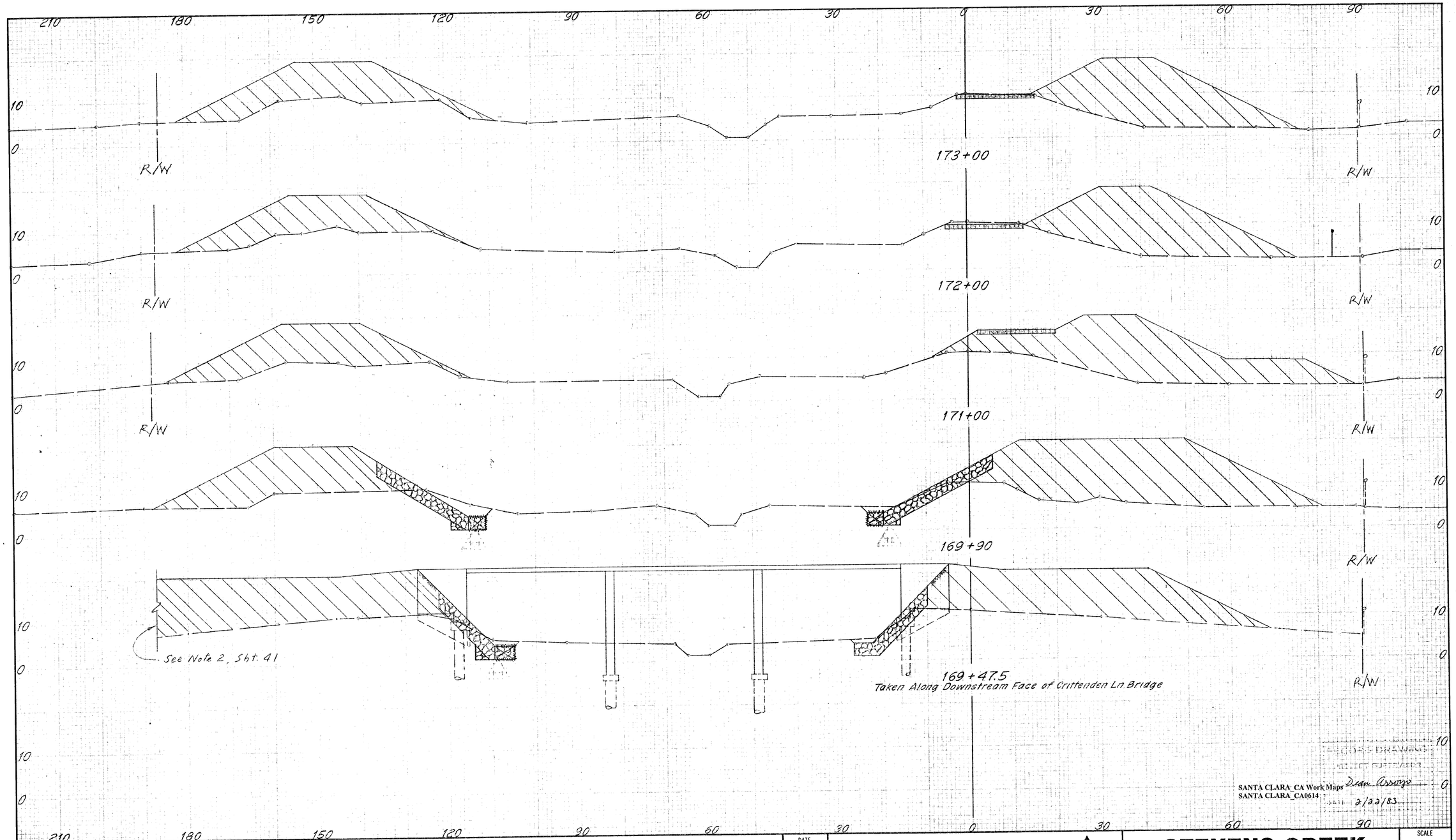
ENGINEERING CERTIFICATION
PROJECT ENGINEER R.C.E. NO. 19214
DIVISION ENGINEER R.C.E. No. 18759

STEVENS CREEK
HWY 101 TO SHORELINE PARK
CROSS SECTIONS

SCALE 1" = 10'
SHEET 41 OF 45

11874

201-04 DWG/UPR



SANTA CLARA_CA Work Maps
SANTA CLARA_CA0614

Dian Arango
3/22/83

REFER TO TRACING FOR LATEST REVISION

REV.	DESCRIPTION	SUB.	APPR.
1	Modified Toe Section.	10-18-82	D.A.

REFERENCE INFORMATION AND NOTES

Pay Limit For Channel Embankment.

DATE 3-1-82
DESIGN Lei/Fowler
DRAWN F.S.W.
CHECKED J. Pandit

Santa Clara Valley Water District

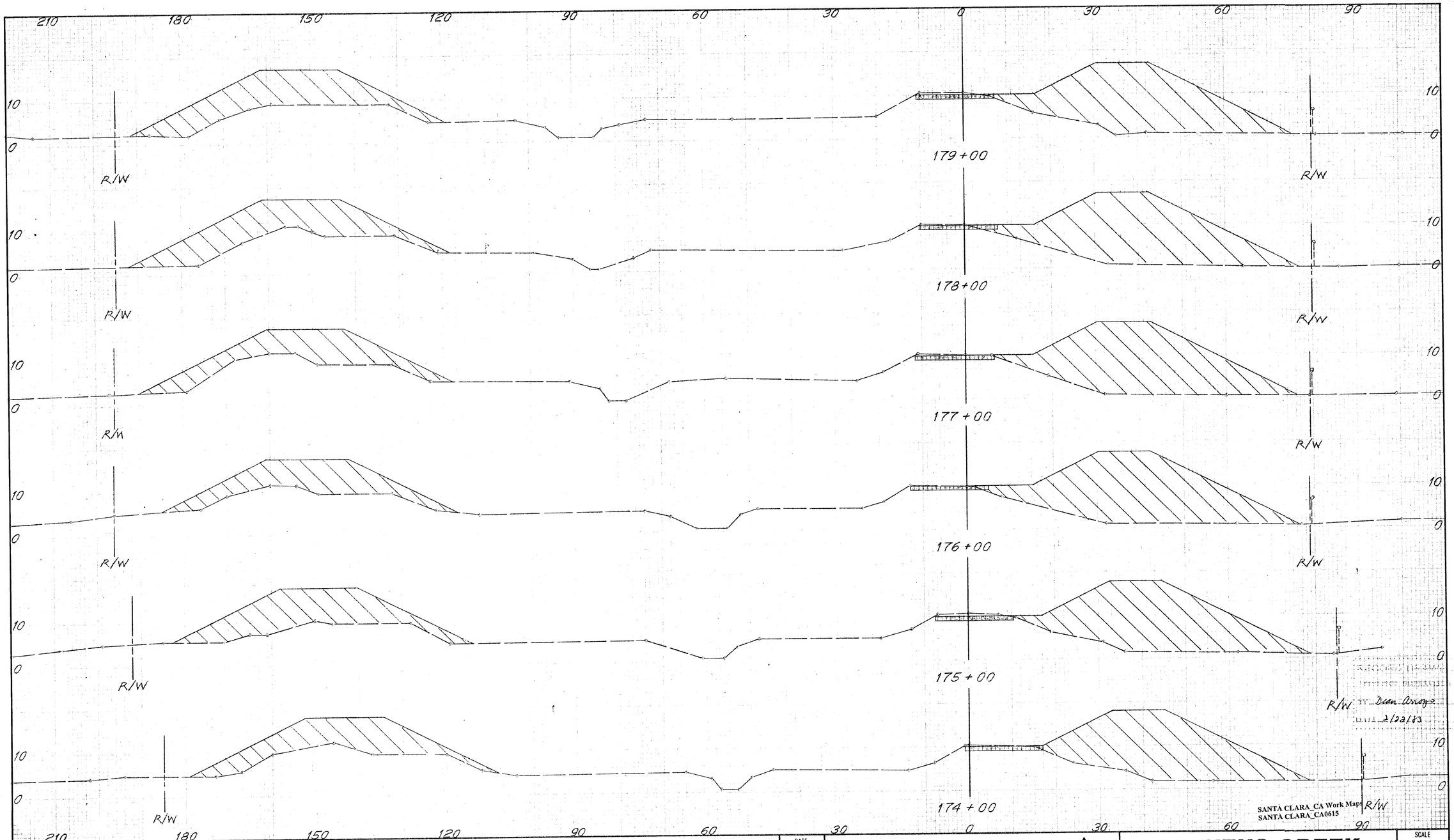
ENGINEERING CERTIFICATION
PROJECT ENGINEER R.C.E. NO. 19214
DIVISION ENGINEER R.C.E. No. 18759

STEVENS CREEK
HWY 101 TO SHORELINE PARK
CROSS SECTIONS

SCALE 1" = 10'

SHEET 42 OF 45

11875



REFER TO TRACING FOR LATEST REVISION			
REV.	DESCRIPTION	SUB.	APPR.

REFERENCE INFORMATION AND NOTES

Pay Limit for Channel Embankment.

DATE 3-1-82
DESIGN Leil/Fowler
DRAWN F.S.W.
CHECKED J. Pandit

Santa Clara Valley Water District

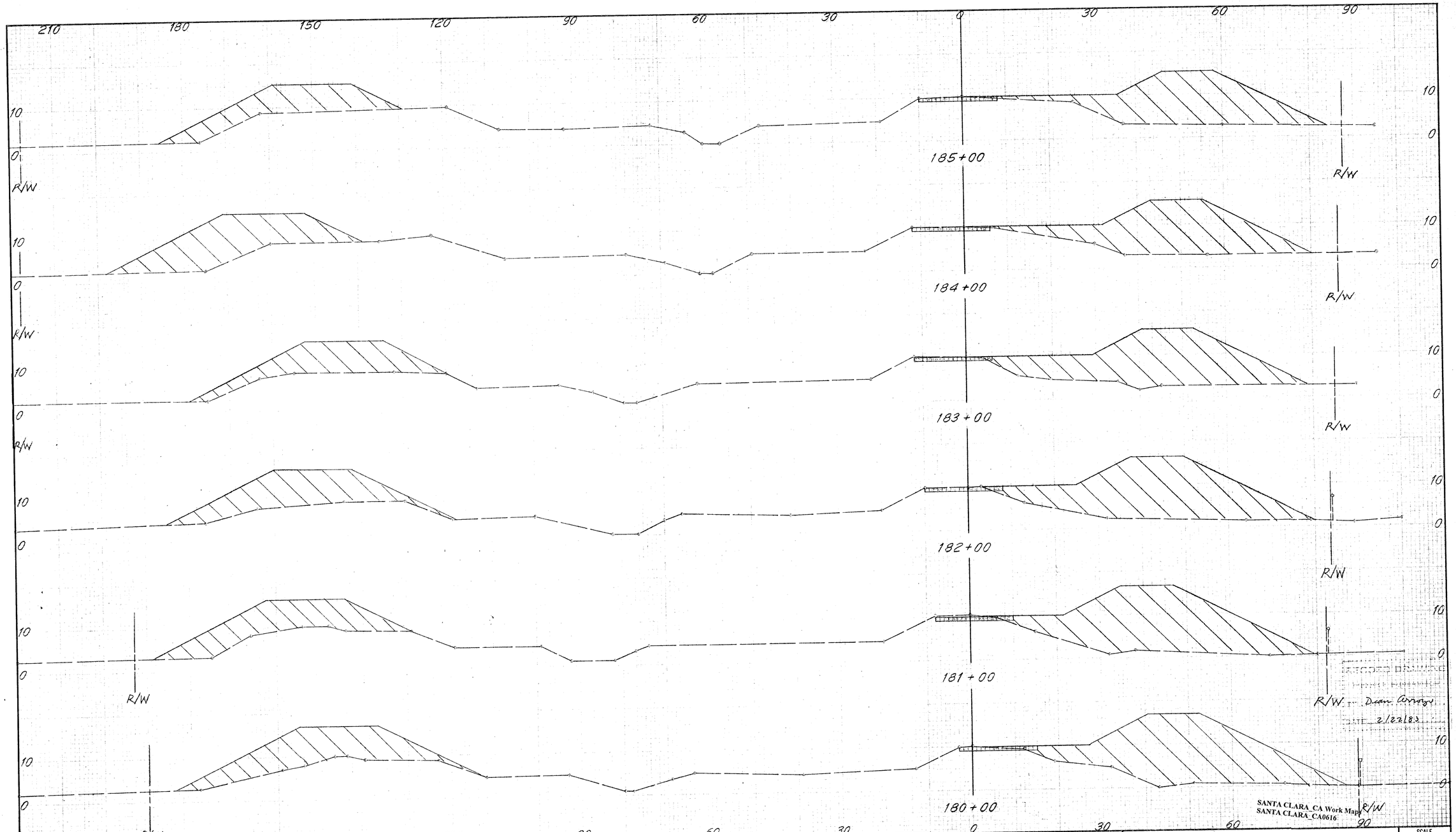
ENGINEERING CERTIFICATION
PROJECT ENGINEER — P.E.E. NO. 19214
DIVISION ENGINEER — R.C.E. No. 18759

STEVENS CREEK
HWY 101 TO SHORELINE PARK
CROSS SECTIONS

SCALE 1" = 10'

SHEET 43 OF 45

11876



SANTA CLARA_CA Work Map
SANTA CLARA_CA0616

REFER TO TRACING FOR LATEST REVISION			
REV.	DESCRIPTION	SUB.	APPR.

REFERENCE INFORMATION AND NOTES

Pay Limit For Channel Embankment.

DATE 3-1-82
DESIGN Lei/Fowler
DRAWN F.S.W.
CHECKED J. Pandit

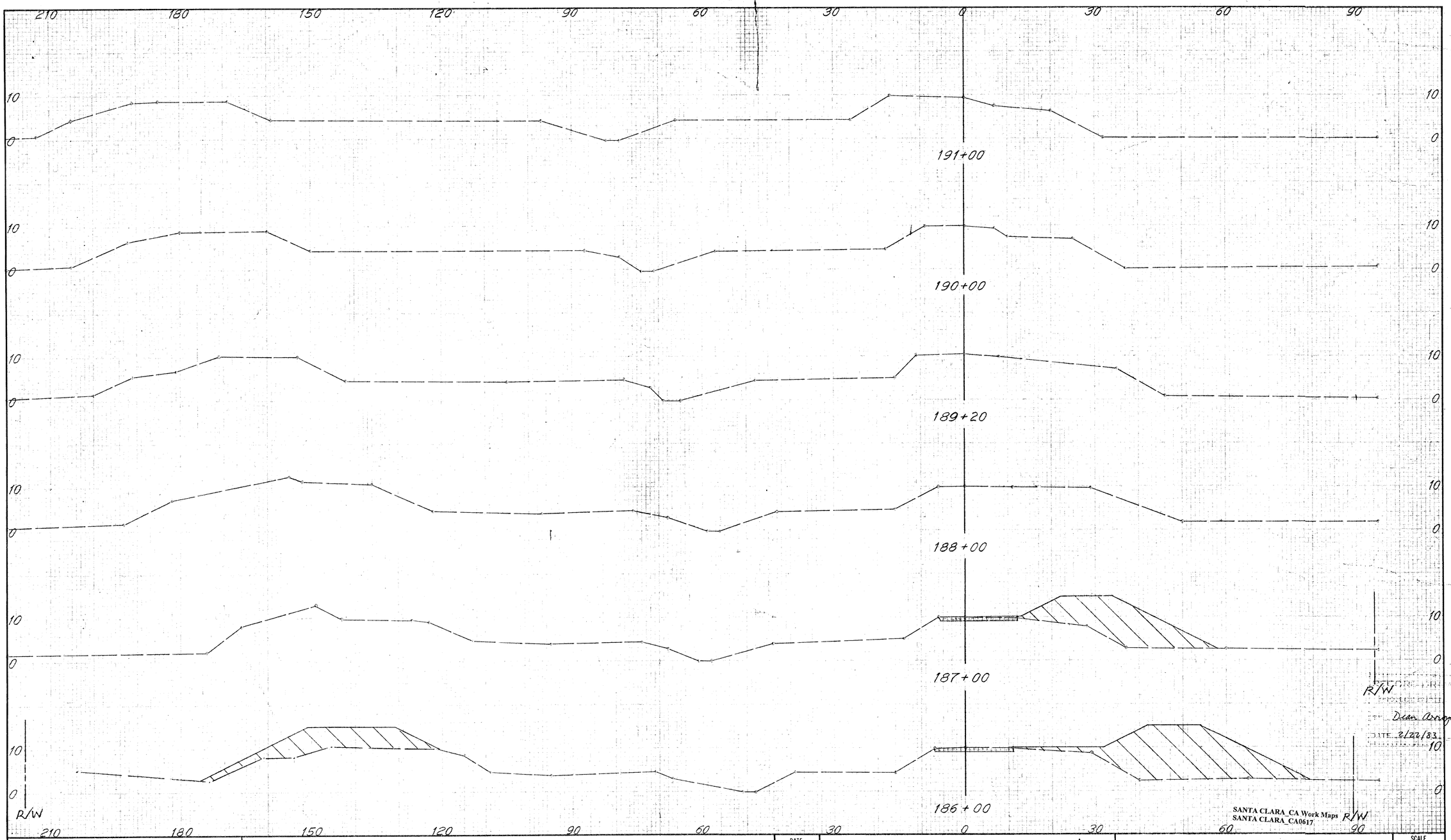
Santa Clara Valley Water District

ENGINEERING CERTIFICATION
PROJECT ENGINEER R.C.E. NO. 19214
DIVISION ENGINEER R.C.E. No. 18759

STEVENS CREEK
HWY 101 TO SHORELINE PARK
CROSS SECTIONS

SCALE 1" = 10'
SHEET 44 OF 45

11877



Dean Arrigo
DATE 2/22/83

SANTA CLARA_CA Work Maps
SANTA CLARA_CA0617

REFER TO TRACING FOR LATEST REVISION			
REV.	DESCRIPTION	SUB.	APPR.

REFERENCE INFORMATION AND NOTES

Pay Limit for Channel Embankment.

DATE	3-1-82
DESIGN	Lei Fowler
DRAWN	F. S. W.
CHECKED	J. Pandit

Santa Clara Valley Water District

ENGINEERING CERTIFICATION
PROJECT ENGINEER R.C.E. No. 12802
DIVISION ENGINEER R.C.E. No. 18759

STEVENS CREEK
HWY 101 TO SHORELINE PARK
CROSS SECTIONS

SCALE 1" = 10'

SHEET 45 OF 45

11878

TAB 6

Schaaf & Wheeler
CONSULTING CIVIL ENGINEERS

100 N. Winchester Blvd., Suite 200
Santa Clara, CA 95050
(408) 246-4848
FAX (408) 246-5624
canderson@swsv.com

TECHNICAL MEMORANDUM

PROJECT:	Recertification of Provisionally Accredited Levees P141 and P143 in Mountain View, California	DATE:	May 6, 2009
PREPARED:	Charles D. Anderson, PE	JOB #:	SCVW.18.08-002B3
SUBJECT:	Freeboard Evaluation for Levees Between Highway 101 and Crittenden Lane		

The Santa Clara Valley Water District (District) has co-signed a PAL agreement to re-certify certain levees within the City of Mountain View, California (City). The District and City are participating in FEMA's Map Modernization Program (MapMod) to reflect the current reality of the natural and man-made environments as they relate to flood hazards. The ultimate goal is to provide updated maps that support a flood insurance program properly aligned with actual risk. Access to accurate maps enhances community-based floodplain decisions, provides jurisdictional agencies with the proper tools for floodplain management and -- most importantly -- provides local property owners with meaningful flood risk data so they may make informed decisions.

District and City participation in MapMod includes the accreditation of District levees that provide protection from the base flood, that is, the one percent annual chance flood also referred to as the "100-year flood." Certain levees believed to meet federal standards for levee performance -- as listed in the Code of Federal Regulations, Title 44, Section 65 (44 CFR §65) -- are thought to be eligible as Provisionally Accredited Levees (PAL) and are currently shown as providing one-percent flood protection on Flood Insurance Rate Maps (FIRMs).

To receive FEMA accreditation, the levee must be shown to conform to the requirements of 44 CFR §65.10 as indicated by the terms of the Provisionally Accredited Levee Program (PAL):

> "To the best of [the District's and City's the [subject] levee…meets the requirements of 44 CFR 65.10 and has been maintained in accordance with an adopted operation and maintenance plan and records of levee maintenance and operation, as well as tests of the mechanized interior drainage system if applicable….."

The purpose of this memorandum is to provide documentation that ***the subject levees meet federal standards for levee performance relative to freeboard*** as described in 44 CFR 65.10.

Limits of Levee Freeboard Evaluation

The District intends to recertify a Provisionally Accredited Levee P141 on the west bank and P143 on the east bank of Stevens Creek in Mountain View, California. The levees were constructed by the Santa Clara Valley Water District in 1983. The reach of accredited levees will stretch from Crittenden Lane on the north to U. S. Highway 101 (Bayshore Freeway) on the south. The approximate total length of levee for recertification on both sides of the creek is 12,000 feet or 2.3 miles.

It may be noted that levees extend downstream (north) of Crittenden Lane on both banks of Stevens Creek, terminating at the outboard San Francisco Bay Levees. Neither the creek levees downstream of Crittenden Lane nor the bay front levees are currently certified to NFIP standards, so the recertification of PAL P143 or PAL P141 south of Crittenden Lane would not remove mapped Special Flood Hazard Areas that result from tidal inundation. Consequently the certification of creek levees downstream of Crittenden Lane currently serves no regulatory purpose. Based on 2007 field surveys taken by the United States Army Corps of Engineers (USACE), the upstream limit of tidal inundation to the one-percent regulatory water surface elevation of 11 feet NAVD, wherever engineered fill has not been placed, is approximately 250 feet south (upstream) of Crittenden Lane along the west bank and approximately 1,500 feet south of Crittenden Lane along the east bank. For convenience, consistency, and efficiency, levee freeboard is evaluated to the upstream face of Crittenden Lane on both banks.

Limits of Hydraulic Evaluation

To compute levee freeboard and ascertain whether NFIP standards for freeboard are met, a one-percent water surface profile for Stevens Creek has been calculated from the outboard San Francisco Bay levee to the downstream face of the Highway 101 Bridge. A water surface profile downstream of Crittenden Lane is necessary to establish backwater conditions at the levees of interest.

Sources of Data Used to Evaluate Levee Freeboard

The primary source of data used in this evaluation is a field survey of the Stevens Creek channel and levees from San Francisco Bay to Highway 101. This certified survey was undertaken in July 2007 by Bestor Engineers, Inc. for the USACE, which used the data to prepare HEC-RAS cross sections. In accordance with our Agreement with the District, Schaaf & Wheeler has used these HEC-RAS sections in conjunction with our own site reconnaissance to complete a hydraulic model for Stevens Creek from San Francisco Bay to Highway 101. The Bestor field surveys have also been used to provide top of levee and top of floodwall elevations. Record drawings provided by the District have been used to corroborate the field information.

Freeboard Requirements

44 CFR 65.10 mandates that riverine levees provide a minimum freeboard of three feet above the water surface level of the base (one-percent) flood. An additional foot of freeboard (i.e. 4 feet of freeboard) is required within 100 feet of either side of structures such as bridges or wherever the flow is constricted. An additional one-half foot of freeboard above the minimum is required at the upstream end of the levee (i.e. 3.5 feet freeboard), tapering to not less than the minimum at the downstream end (i.e. 3 feet freeboard).

Methodology

To evaluate whether required freeboard above the base flood elevation are provided by the existing levees, the HEC-RAS model prepared by the USACE in 2007 has been corroborated and revised by Schaaf & Wheeler to reflect current conditions within the creek channel and our evaluation of relevant hydraulic parameters including channel roughness, bridge modeling, transition losses and boundary conditions. Subcritical flow computations have been made since there are no locations with supercritical flow. Summary HEC-RAS model results for Stevens Creek's base flood (one-percent) are attached. A complete digital version of the HEC-RAS model used in freeboard evaluation is enclosed.

Channel Roughness

In one-dimensional open channel flow analysis as performed using HEC-RAS, a single parameter known as "Manning's n" is used to represent the retarding forces to flow imposed by the channel bed and banks. Values for "n" are published in the literature – and in the absence of high water marks with which to calibrate stream reaches with known discharge (as is the case for Stevens Creek) – are often relied upon for hydraulic modeling. When selecting roughness values, it is important to remember that in one-dimensional flow analysis, Manning's "n" accounts for the flow resistance due to a host of hydraulic phenomena beyond boundary shear.

Several sources have been used to estimate roughness factors for water surface profile determination within Stevens Creek. These include "n" values published by Henderson (1966) and Chow (1959), engineering judgment, and procedures outlined by the Corps of Engineers (EM 1110-2-1601, July 1991). Channel roughness considers the channel as if maintained in no worse than its present condition, evaluated as if it were the winter flood season.

Roughness elements along the wetted perimeter of Stevens Creek can vary across an individual cross section. For instance the channel cross section might contain elements of grassed banks, mature trees, a tidal bench, shrubs or brush, a maintenance road and/or bare earth. To compute water surface elevations in a channel with variable roughness using a one-dimensional model (i.e. with a mean velocity), it is necessary to estimate an effective (composite) roughness value for each cross section. Flow velocities vary across the channel due to variation in both the flow depth and roughness from one channel element to the next. To calculate mean flow velocity without actually subdividing each channel section, several methods are suggested in the literature for estimating a composite roughness value within non-uniform channels.

HEC-RAS calculates a composite "n" value based (apparently) on an assumption that average velocities within each channel element are equal and equivalent to the mean channel velocity as a whole. (HEC, 1998) Since this may not necessarily be the case when there is a wide variation in roughness elements, several other methods for weighting "n" are considered and used to select roughness values based on judgment. Composite weighting generally involves breaking a representative reach cross section into elements that reflect cross sectional geometry and the various roughness characteristics, such as bed material, channel sinuosity, vegetation and obstructions. Roughness values for each element are estimated, and a weighting equation is used to obtain the equivalent roughness coefficient for that reach.

Lotter assumed that the total discharge in each section is equal to the sum of the discharges of individual areas subdivided by roughness (i.e. conservation of mass). The resultant equivalent roughness coefficient formula, consistent with US Army Corps of Engineers engineer manual EM 1110-2-1601, is provided by Chow as Equation 6-19:

$$\bar{n} = \frac{P\,R^{5/3}}{\sum_{1}^{N}\left(\frac{P_N\,R_N^{5/3}}{n_N}\right)} = \frac{P\,R^{5/3}}{\frac{P_1\,R_1^{5/3}}{n_1} + \frac{P_2\,R_2^{5/3}}{n_2} + \ldots + \frac{P_N\,R_N^{5/3}}{n_N}}$$

where $\bar{n}$ = composite roughness coefficient for cross section
P = total wetted perimeter of cross section (feet)
R = total hydraulic radius of cross section (feet)
P_i = wetted perimeter of cross section element i (feet)
R_i = hydraulic radius of cross section element i (feet)
N_i = Manning's roughness coefficient for cross section element i

It could be assumed that the total force resisting the flow is equal to the sum of the forces resisting the flow developed in the subdivided areas (Pavlovskii, Muhlhofer, Einstein and Banks). The resultant equivalent roughness coefficient formula is provided by Chow (1959) as Equation 6-18:

$$\bar{n} = \frac{\left[\sum_{1}^{N} P_N n_N\right]^{1/2}}{P^{1/2}} = \frac{\left(P_1 n_1^{\ 2} + P_2 n_2^{\ 2} + \ldots + P_N n_N^{\ 2}\right)^{1/2}}{P^{1/2}}$$

where $\bar{n}$ = composite roughness coefficient for cross section
P = total wetted perimeter of cross section (feet)
P_i = wetted perimeter of cross section element i (feet)
n_i = Manning's roughness coefficient for cross section element i

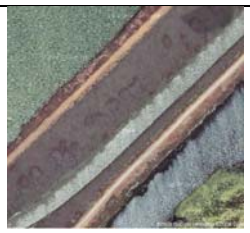
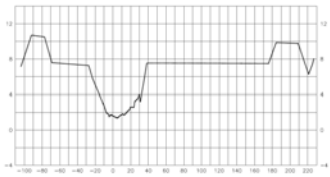
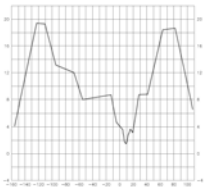
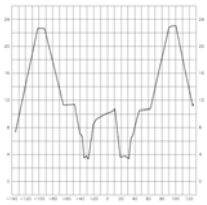
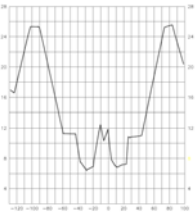
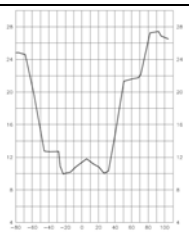
In USACE EM 1110-2-2601 the Colbatch method, which weights roughness based on subdivided cross sectional area is said to be more accurate than an assumption of equal velocity. The resultant equivalent roughness coefficient formula from EM 1110-2-1601 (5-22) is:

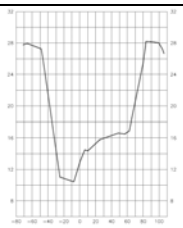
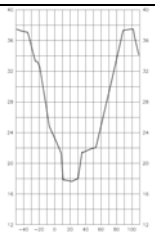
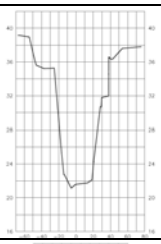
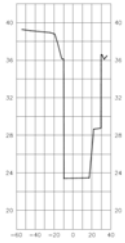
$$\bar{n} = \frac{\left[\sum_{1}^{N} A_N n_N^{\ 1.5}\right]^{2/3}}{A^{2/3}} = \frac{\left(A_1 n_1^{\ 1.5} + A_2 n_2^{\ 1.5} + \ldots + A_N n_N^{\ 1.5}\right)^{2/3}}{A^{2/3}}$$

where $\bar{n}$ = composite roughness coefficient for cross section
A = total area of cross section (square feet)
A_i = area of cross section element i (square feet)
n_i = Manning's roughness coefficient for cross section element i

Table 1 presents the selection of channel roughness by reach, from the mouth of Stevens Creek to Highway 101. Detailed spread sheets are attached for each reach that show the breakdown of roughness elements and composite roughness calculations. Reach descriptions are based on channel stationing that begins at the mouth of the creek. The selected roughness coefficient is derived as an average of the roughness estimated using the sum of forces method and the Colbatch method, rounded to the nearest 0.005. Using the conveyance method produces unrealistically low composite roughness characteristics in those reaches with heavy vegetation within the channel.

Table 1
Channel Roughness Coefficients Used for Freeboard Evaluation

Station		Photo	Representative Section	Composite Roughness Coefficient (Manning's "n")			
From	To			Conveyance	∑Force	Colbatch	Selected
0+13	64+20			0.020	0.028	0.026	0.030
64+20	84+67			0.022	0.039	0.033	0.035
84+67	93+00			0.030	0.074	0.059	0.065
93+00	123+98			0.030	0.063	0.056	0.060
123+98	126+94			0.022	0.028	0.027	0.030

Station		Photo	Representative Section	Composite Roughness Coefficient (Manning's "n")			
From	To			Conveyance	∑Force	Colbatch	Selected
126+94	132+01			0.033	0.050	0.045	0.050
132+01	141+37			0.030	0.079	0.068	0.075
141+37	142+13			0.040	0.074	0.063	0.070
142+13	143+23			-----	-----	-----	0.017

Bridge Modeling

In addition to the energy required to overcome channel resistance, structures such as bridges and culverts also cause energy losses, which can result in a raised water surface profile. Methods provided by HEC-RAS for analyzing bridges and culverts under low flow and pressurized conditions are employed in the backwater computations for Stevens Creek.

Several methods are available through HEC-RAS to compute energy losses through a bridge. The "energy only" or standard step method handles a bridge section without piers in the same manner as a natural river section, except that the area between the low chord of the bridge (soffit) and the top of road is subtracted from the total cross-sectional area, and the wetted perimeter is increased where water is in contact with the bridge. Increased frictional resistance due to the added wetted perimeter is included in the energy loss through the structure. This method is appropriate where the base flood elevation does not touch the bridge soffit, which is the case for the pedestrian bridge downstream of Crittenden Lane, since there are no abutments within the creek, and the structure does not interfere with flow.

When bridge piers are present as is the case for the Crittenden Lane bicycle bridge, in addition to the "energy only" method, conservation of momentum is applied by using a coefficient of drag (1.33 for a semicircular nose and tail), as is Yarnell's method for subcritical "Class A" low flow through the bridge (with a pier coefficient of 0.90 for a semicircular nose and tail). HEC-RAS calculates losses through the bridge using all three methods and applies the answer with the highest calculated upstream energy grade.

For completeness, HEC-RAS's "pressure/weir" feature computes losses through the structure for pressure (orifice) flow, weir flow over the top, or a combination of both. Changes to the water surface profile resulting from the bridge are calculated based on hydraulic formulae that estimate the change in energy and water surface elevation through the bridge. An orifice coefficient of 0.80 is used to represent a typical bridge (orifice in thick wall).

HEC-RAS results indicate that both of the modeled bridges between Highway 101 and San Francisco Bay function under Class A (subcritical) low flow conditions with base flood discharge in Stevens Creek. The lowest part of the bridge superstructure is well above the energy grade line at both locations. In both instances, the "energy only" method provides the highest bridge losses.

Transition Losses

An energy loss also takes place just upstream and downstream from each structure as flow contracts at a ratio of 1:1 into a flow constriction and expands at a ratio of 1:4 out of a flow constriction such as bridge abutments. A flow contraction coefficient of 0.1 is used for gradual transitions, which characterize the majority of Stevens Creek. Similarly a flow expansion coefficient of 0.3 is used for gradual transitions. (Reference: USACE, Hydrologic Engineering Center) Contraction and expansion coefficients are increased to 0.3 and 0.5 respectively wherever turbulent conditions create the potential for energy loss, such as at a bridge (or culvert), channel bend, pool, or maintenance access ramp.

Boundary Conditions

For subcritical backwater computations, the upstream boundary condition is discharge and the downstream boundary condition is water surface elevation (stage). As directed by the District, one percent (base flood) discharge published in the effective Flood Insurance Study for the City of Mountain View is used as the upstream boundary condition. According to the Santa Clara County FIS redone as part of the MapMod process (proposed effective date May 18, 2009), the one percent discharge at Highway 101 is 5,750 cfs. The effective FIS lists the one percent discharge at Crittenden Lane as 2,350 cfs due to restrictions in channel capacity. This analysis does not find a channel capacity restriction between Highway 101 and Crittenden Lane and uses the published discharge of 5,750 cfs throughout the levee re-certification reach with additional coincident discharge from local outfalls and pump stations as described in the Residual Interior Drainage Analysis.

The published FIS shows a one-percent stillwater water surface elevation of 10.7 feet NAVD at the downstream limit of hydraulic study, which is the outboard levee at San Francisco Bay. To establish the starting water surface elevation for the base flood profile calculated herein, a coincident one-percent tide analysis has been performed to provide the downstream boundary.

A *19-year mean tide cycle* has been established for San Francisco Bay and other geographical locations on the West Coast. This cycle represents average tide heights over a specific period known as the tidal epoch, which spans the 19 years it takes for every possible combination of relative positions for the sun, moon and earth to occur. A mixed tide cycle predominates on the West Coast of the United States. This cycle consists of two high tides (one higher than the other) and two low tides (one lower than the other) each lunar day.

Based on calculations for these relative celestial positions, it is possible to predict tides for any day of the year at any time of the day. *Astronomic tides*, created by the gravitational forces of the moon and sun acting on earth's oceans, are provided in tide prediction calendars. The mean tide cycle is simply the long-term average of astronomic tides. *Observed tides*, on the other hand, are actual tidal elevations recorded by National Oceanic and Atmospheric Administration (NOAA) gaging stations located throughout coastal areas.

Traditionally, Mean Higher High Water (MHHW) has been used as the backwater condition where riverine (freshwater) runoff meets an estuarine (saltwater) body. However, evidence shows that mean tide elevations are not necessarily an appropriate boundary condition during storm events and tide elevations in San Francisco Bay are elevated (relative to predicted tides) during periods of heavy rainfall. Furthermore, the relationship between coincident tides and maximum annual runoff can be quantified and used in the model, providing for a more statistically correct solution than an arbitrarily selected tide condition.

The El Niño storm of February 2-3, 1998 provided an ideal event for examining potential correlations between runoff events and tide action. While stream runoff as measured by local gages often approached historic recorded levels, observed tides in San Francisco Bay were substantially higher than predicted.

Figure 1 shows predicted and recorded tides in early February 1998 at Redwood City, which has the closest NOAA tide gage to Stevens Creek. Recorded tides during the week of this runoff event were consistently higher (on the order of up to 4 feet) than the astronomic (predicted) tide heights due to storm surge. As a control, observed tide heights are compared to predicted tides six months later at the same station, using the same sets of data. Figure 2 shows tide elevations during early August 1998, when there is very close agreement between the predicted and the actual tides and no rainfall. Both figures present tides on the local Mean Lower Low Water (MLLW) datum. Historic tide records have been examined to see whether the phenomenon demonstrated in February 1998 at Redwood City occurred elsewhere in the Bay Area and during other heavy runoff events in the past. Results of this investigation presented in Table 2 indicate that during the 1998 runoff event, similar rises in tide elevations (over astronomic) were experienced at other recording tide stations in the Bay.

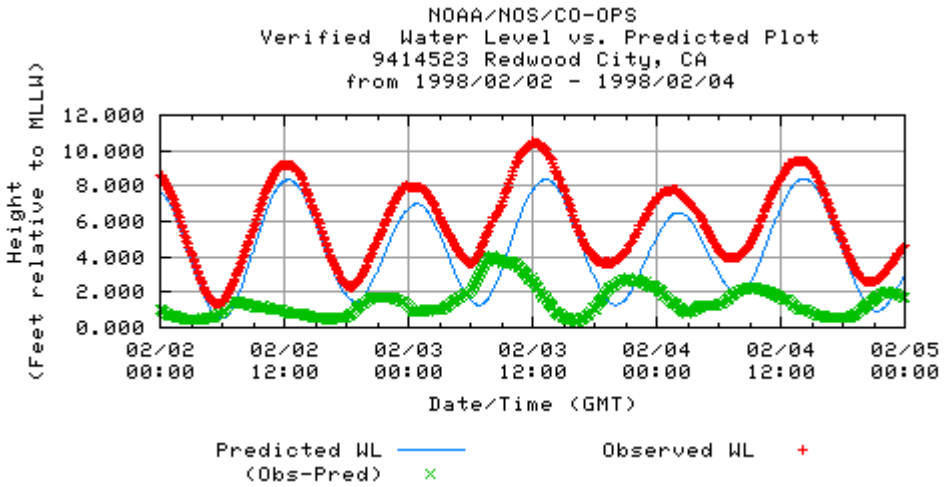


Figure 1. San Francisco Bay Tide during Feb 2-3, 1998 Storm Event

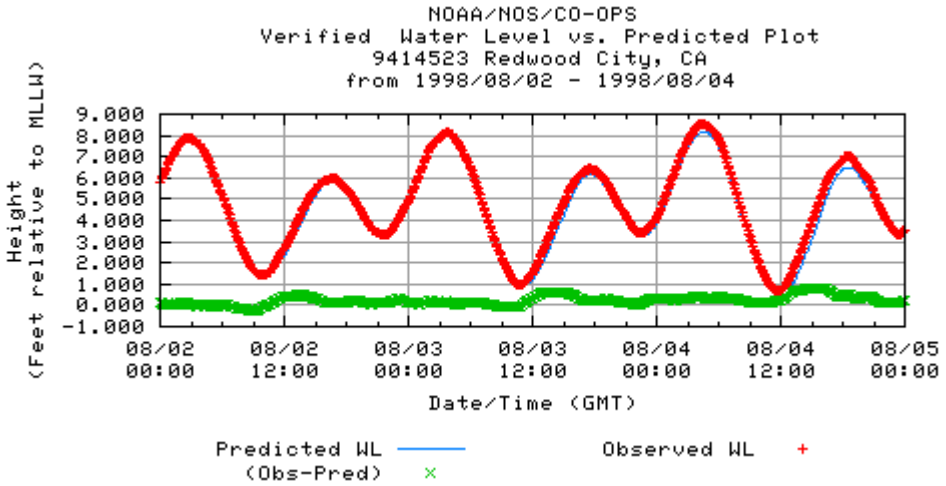


Figure 2. San Francisco Bay Tide during early August 1998

Table 2
Tides During February 1998 Storm Surge

Location	Maximum Difference Between Predicted and Recorded Tides in feet	
	Higher High	Lower Low
Golden Gate	2.0	2.9
Alameda	2.0	2.7
Redwood City	2.0	2.7
Monterey Harbor	1.7	1.8

The observed phenomenon presented in Table 2 is not strongly dependent upon tide gage location, particularly within San Francisco Bay, and is exhibited during many historic storm events. Data indicate that higher tides as observed during the February 1998 event are not an isolated incident; rather, higher than predicted tides can be expected during storm events that generate significant runoff. Increases in the data set between observed tides over predicted tides range from 0.3 foot to 2.0 feet for the higher high tide, and from 0.9 foot to 3.0 feet for the lower low tide.

From observed historical data, it appears that storm-related forces induce higher tides during rainfall events, and by extension, runoff events. This phenomenon may be due to a number of meteorological or hydrologic factors. NOAA refers to the term “inverse barometer effect”, and defines it as higher tides that are caused by lower barometric pressures associated with winter storm systems. References to “storm surges”, the meteorological effects of low barometric pressures and/or strong southerly winds, are also found in the literature.

The exact nature and cause of this phenomenon, however, are not as important as potential impacts to backwater conditions for Stevens Creek. To model an appropriate San Francisco Bay tidal cycle during the one percent storm event, elevations for each critical point in the tide cycle are adjusted based on the one-percent conditional probability of coincident occurrence with the annual maximum discharge of San Francisquito Creek at Stanford, which represents the closest USGS streamflow gaging location with sufficient length of record for analysis. This procedure is as described by Dixon (1986), whose hypothesis was that high tide events tend to occur the same day as flood flow events using conditional probability:

$$P(x,y) = P(x|y)\,P(y)$$

where P(x,y) is the probability of occurrence of x and y; P(x|y) is the probability of occurrence of x given y; P(y) is the probability of occurrence of y; x is tide elevation; and y is maximum annual peak discharge. Since we are interested only in annual maximum discharges, P(y) is one and the probability of joint occurrence, P(x,y), is equal to the probability of x given y.

The Higher High tide is taken from a fitted probability curve using the median plotting position for every recorded tide extreme at San Francisco (Presidio/Golden Gate) that occurred within 24 hours of the recorded maximum annual discharge. Figure 3 shows the probability distribution on the MLLW datum.

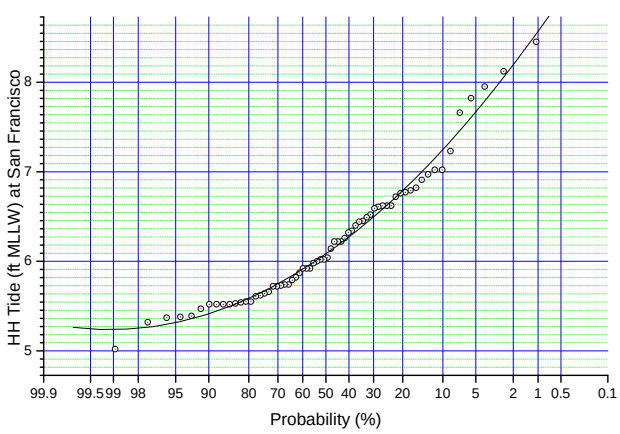


Figure 3. Coincident 1% Tide at San Francisco

The coincident one-percent high tide elevation at San Francisco is 8.63 feet MLLW. A tide elevation at the Golden Gate can be corrected for location within San Francisco Bay. The correction at the mouth of Stevens Creek is to add 2.6 feet to high tides. On the MLLW datum, the coincident one-percent tide for Stevens Creek is 11.23 feet. By subtracting 4.1 feet, the tide is converted to 7.13 NGVD (USACE, 1984). Using the Vertcon software, 2.68 feet are added at this location to produce a coincident one-percent high tide at the mouth of Stevens Creek of ***9.8 feet NAVD***.

The timing of coincident tide elevations with peak rainfall/runoff is also a random process. Since there are not sufficient data to statistically analyze the impact of tide timing, it is assumed that peak riverine discharge occurs during the coincident high tide. During the February 1998 event, this turned out to be the case.

FREEBOARD

Freeboard provides a measure of safety that compensates for the many unknown and difficult-to-quantify parameters that affect the calculation of flood elevations. These factors include uncertainty in rainfall data, soil loss parameters, watershed urbanization, wave action, debris at bridge openings, and general uncertainties in hydrologic and hydraulic procedures. Freeboard is usually expressed in terms of feet above the design base flood elevation. To meet FEMA standards, freeboard is necessary whenever a levee system, including structural floodwalls, is used to provide flood protection.

When mapping flood-prone areas, FEMA only recognizes those levee systems meeting their criteria, which includes a minimum three feet of freeboard whenever the design one-percent water surface elevation is carried above the natural ground elevation. An additional six inches of freeboard (3.5 feet above the water surface) is required at the upstream end of the levee / floodwall system, tapering to the minimum freeboard of 3.0 feet at the downstream end of the levee. An additional foot of freeboard (4.0 feet above the water surface) must be provided within 100 feet of each side of any structure, such as a bridge or culvert.

FEMA does not impose a freeboard requirement when the base flood could be carried without the use of a levee system. Depending upon the base discharge, therefore, portions of the Stevens Creek levees may not be necessary to provide regulatory flood protection and could in theory be decertified without impacting the FIRM.

Stevens Creek Levee System

Four distinct levee systems have been evaluated for freeboard:

1. West Bank Levee (P141) from Crittenden Lane to high ground at La Avenida Street.
2. West Bank Levee (P141) from high ground at La Avenida Street to Highway 101.
3. East Bank Levee (P143) from Crittenden Lane to high ground opposite La Avenida Street, including a structural floodwall.
4. East Bank Levee (P143) from high ground opposite La Avenida Street to Highway 101.

Although not included in the levee recertification effort for reasons described previously, riverine levees downstream of Crittenden Lane are assumed to hold at their surveyed elevation during any overtopping, as this provides the most conservative backwater estimate at Crittenden Lane. Channel capacity has been estimated in downstream reaches by running 5,750 cfs against the coincident one-percent tidal stage in San Francisco Bay. Discharge in excess of channel capacities within various downstream reaches is allowed to spill over the existing levee(s) into the tidally flooded portion of Mountain View.

Freeboard Evaluation

Attached tables and profiles provide the following information:

1. Main channel invert and natural bank elevations on the west and east side of Stevens Creek.
2. One-percent water surface profile based on HEC-RAS hydraulic model.
3. Determination of regulatory levee condition. (Is the 1% water surface above natural grade?)
4. Required NFIP freeboard elevation. This is calculated even if a levee reach is not considered regulatory.
5. Surveyed levee and floodwall elevations.

***Levee System No. 1* (P141)**

From Crittenden Lane (Station 84+39) to Station 121+99, the one-percent water surface profile is above the natural ground elevation, so the west bank levee must provide adequate freeboard for certification. Levee System No. 1 meets all FEMA criteria for freeboard from Crittenden Lane to its upstream end at the La Avenida Street cul-de-sac (Station 126+94). Between Station 126+94 and Station 127+98, the west bank is considered to be on compacted fill, which was placed for the cul-de-sac. The elevation of fill is above the crest height of adjacent Levee System Nos. 1 and 2 and there is no levee condition; although if this were to be considered a levee condition, adequate freeboard is provided.

***Levee System No. 2* (P141)**

Downstream of Highway 101 (Station 143+23), the west bank levee begins at Station 141+37 and continues to high ground near La Avenida Street at Station 128+13. An examination of adjacent grade based on field surveys blended with 2006 Santa Clara County LiDAR topography indicates that the adjacent grade on the west bank is higher than the calculated one-percent water surface elevation throughout this reach. If this levee system cannot be certified to meet USACE stability criteria, the base flood would still be contained within the channel banks, even by assuming the levee did not exist. Nonetheless, FEMA levee freeboard criteria have been evaluated for the entire reach as if levee certification would be required. As the profiles indicate, adequate freeboard is provided for all of Levee System No. 2. It may be noted for the upcoming geotechnical evaluation, however, that this would be considered a levee reach of lower risk relative to Levee System Nos. 1 and 3.

***Levee System No. 3* (P143)**

This levee system extends from Crittenden Lane (Station 84+39) to the end of the structural floodwall opposite the La Avenida Street cul-de-sac. Freeboard is provided by a reinforced concrete floodwall between Station 111+70 and Station 126+94. Levee System No. 3 meets NFIP freeboard criteria. The levee is in a regulatory levee condition from Crittenden Lane upstream to Station 123+98.

There is no levee between the end of the structural floodwall at Station 126+94 to approximately Station 129+00.

***Levee System No. 4* (P143)**

Upstream from the end of the structural floodwall, the levee (defined as artificial fill above the elevation of adjacent grade) begins again at approximate Station 129+00 and continues in the upstream direction to Station 141+68, where the levee substantially ends in high ground. Levee System No. 4 is not considered to be a regulatory levee since the base flood would be contained within channel banks if the levee were assumed not to exist. NFIP freeboard criteria have been evaluated, however, and the levee could be certified based on freeboard. Since a regulatory levee system is not needed upstream of the floodwall, Levee System No. 4 may also be considered a levee reach of lower relative risk during the geotechnical evaluation.

Conclusion

East and west bank levee and floodwall systems along Stevens Creek between Highway 101 and Crittenden Lane can be certified to meet NFIP freeboard criteria. Existing field conditions as of July 2008 have been used as the basis for this conclusion. The District will maintain Stevens Creek in accordance with its adopted stream maintenance plan for vegetation growth and sediment management, and the levees in accordance with its levee operations and maintenance manual (all enclosed).

SCVWD Levee Recertification
Stevens Creek
Composite Roughness Calculations

Reach 1
Station 0+13 to Station 64+20

Channel Element	Elev	b	SS	n
Left Levee Bank			3	0.03
Left Tidal Bench	7.5	40		0.03
Left Channel Bank			2.75	0.025
Channel	2.0	35		0.02
Right Channel Bank			2.75	0.025
Right Tidal Bench	7.5	140		0.03
Right Levee Bank			3	0.03

Total Discharge	**5,750**	cfs
WSEL	**10.0**	feet

Element	n_i	A_i	P_i	R_i	$P_iR_i^{5/3}/n_i$	$P_in_i^2$	$A_in_i^{1.5}$	Q_i	V_i	$V_i^3A_i$
Left Bank	0.030	9.38	7.91	1.19	350	0.007	0.049	20	2.09	86
Left Tidal Bench	0.030	100.00	40.00	2.50	6,140	0.036	0.520	344	3.44	4,058
Left Channel Bank	0.025	79.41	16.09	4.93	9,205	0.010	0.314	515	6.49	21,686
Channel	0.020	280.00	35.00	8.00	56,000	0.014	0.792	3,134	11.19	392,660
Right Channel Bank	0.025	79.41	16.09	4.93	9,205	0.010	0.314	515	6.49	21,686
Right Tidal Bench	0.030	350.00	140.00	2.50	21,490	0.126	1.819	1,203	3.44	14,202
Right Levee Bank	0.030	9.38	7.91	1.19	350	0.007	0.049	20	2.09	86
Summation		907.56	263.00	3.45	102,741	0.210	3.855	5,750		454,464

Average Velocity	6.34	fps
Composite n (Conveyance)	0.020	
Composite n (Force)	0.028	
Composite n (Colbatch)	0.026	
α	1.97	

n used for freeboard eval.	0.030
n used for scour analysis	0.020

SCVWD Levee Recertification
Stevens Creek
Composite Roughness Calculations

Reach 2
Station 64+20 to Station 84+67

Channel Element	Elev	b	SS	n
Left Levee Bank			3	0.06
Left Tidal Bench	8.7	45		0.045
Left Channel Bank			2	0.025
Channel	3.0	20		0.02
Right Channel Bank			2.75	0.025
Right Tidal Bench	8.7	12		0.05
Right Levee Bank			2.5	0.03

Total Discharge	**5,750**	cfs
WSEL	**12.0**	feet

Element	n_i	A_i	P_i	R_i	$P_iR_i^{5/3}/n_i$	$P_in_i^2$	$A_in_i^{1.5}$	Q_i	V_i	$V_i^3A_i$
Left Bank	0.060	16.34	10.44	1.57	367	0.038	0.240	30	1.84	102
Left Tidal Bench	0.045	148.50	45.00	3.30	7,315	0.091	1.418	600	4.04	9,778
Left Channel Bank	0.025	70.11	12.75	5.50	8,739	0.008	0.277	716	10.22	74,806
Channel	0.020	180.00	20.00	9.00	38,941	0.008	0.509	3,192	17.74	1,004,156
Right Channel Bank	0.025	96.40	16.68	5.78	12,419	0.010	0.381	1,018	10.56	113,556
Right Tidal Bench	0.050	39.60	12.00	3.30	1,756	0.030	0.443	144	3.63	1,901
Right Levee Bank	0.030	13.61	8.89	1.53	603	0.008	0.071	49	3.63	652
Summation		564.56	125.75	4.49	70,139	0.193	3.338	5,750		1,204,950

Average Velocity	10.18	fps
Composite n (Conveyance)	0.022	
Composite n (Force)	0.039	
Composite n (Colbatch)	0.033	
α	2.02	

n used for freeboard eval.	0.035
n used for scour analysis	0.020

SCVWD Levee Recertification
Stevens Creek
Composite Roughness Calculations

Reach 3
Station 84+67 to Station 93+00

Channel Element	Elev	b	SS	n
Left Levee Bank			2.5	0.03
Maintenance Road at Toe	11.2	15		0.025
Left Channel Bank (L)			2	0.04
Left Channel	3.5	7		0.025
Left Channel Bank (Rt)			1.5	0.05
Channel Island	10	30		0.15
Right Channel Bank (L)			1.3	0.05
Right Channel	3.5	15		0.025
Right Channel Bank (Rt)			2	0.04
Maintenance Road at Toe	10.5	15		0.025
Right Levee Bank			2.2	0.03

Total Discharge	**5,750**	cfs
WSEL	**14.0**	feet

Element	n_i	A_i	P_i	R_i	$P_iR_i^{5/3}/n_i$	$P_in_i^2$	$A_in_i^{1.5}$	Q_i	V_i	$V_i^3A_i$
Left Bank	0.030	9.80	7.54	1.30	389	0.007	0.051	28	2.82	221
Maintenance Road at Toe	0.025	42.00	15.00	2.80	3,337	0.009	0.166	237	5.65	7,582
Left Channel Bank (L)	0.040	102.41	17.22	5.95	8,405	0.028	0.819	598	5.84	20,367
Left Channel	0.025	73.50	7.00	10.50	14,097	0.004	0.291	1,003	13.64	186,587
Left Channel Bank (Rt)	0.050	70.69	11.72	6.03	4,685	0.029	0.790	333	4.71	7,404
Channel Island	0.150	120.00	30.00	4.00	2,016	0.675	6.971	143	1.19	205
Right Channel Bank (L)	0.050	61.26	10.66	5.75	3,931	0.027	0.685	280	4.56	5,823
Right Channel	0.025	157.50	15.00	10.50	30,209	0.009	0.623	2,149	13.64	399,829
Right Channel Bank (Rt)	0.040	98.00	15.65	6.26	8,323	0.025	0.784	592	6.04	21,596
Maintenance Road at Toe	0.025	52.50	15.00	3.50	4,841	0.009	0.208	344	6.56	14,808
Right Levee Bank	0.030	13.48	8.46	1.59	613	0.008	0.070	44	3.23	456
Summation		801.14	153.25	5.23	80,846	0.830	11.457	5,750		664,877

Average Velocity	7.18	fps
Composite n (Conveyance)	0.030	
Composite n (Force)	0.074	
Composite n (Colbatch)	0.059	
α	2.24	

n used for freeboard eval.	0.065
n used for scour anal.	0.030

SCVWD Levee Recertification
Stevens Creek
Composite Roughness Calculations

Reach 4
Station 93+00 to Station 123+98

Channel Element	Elev	b	SS	n
Left Levee Bank			2.25	0.03
Maintenance Road at Toe	11.5	15		0.025
Left Channel Bank (L)			1.4	0.04
Left Channel	7.0	15		0.025
Left Channel Bank (Rt)			2.5	0.05
Channel Island	11	22		0.15
Right Channel Bank (L)			2	0.05
Right Channel	7	15		0.025
Right Channel Bank (Rt)			1.3	0.04
Maintenance Road at Toe	11	20		0.025
Right Levee Bank			2	0.03

Total Discharge	**5,750**	cfs
WSEL	**20.0**	feet

Element	n_i	A_i	P_i	R_i	$P_iR_i^{5/3}/n_i$	$P_in_i^2$	$A_in_i^{1.5}$	Q_i	V_i	$V_i^3A_i$
Left Bank	0.030	81.28	20.93	3.88	6,694	0.019	0.422	203	2.50	1,267
Maintenance Road at Toe	0.025	127.50	15.00	8.50	21,241	0.009	0.504	644	5.05	16,454
Left Channel Bank (L)	0.040	67.73	7.74	8.75	7,188	0.012	0.542	218	3.22	2,260
Left Channel	0.025	195.00	15.00	13.00	43,124	0.009	0.771	1,308	6.71	58,863
Left Channel Bank (Rt)	0.050	110.00	10.77	10.21	10,356	0.027	1.230	314	2.86	2,562
Channel Island	0.150	198.00	22.00	9.00	5,711	0.495	11.503	173	0.87	133
Right Channel Bank (L)	0.050	88.00	8.94	9.84	8,081	0.022	0.984	245	2.79	1,902
Right Channel	0.025	195.00	15.00	13.00	43,124	0.009	0.771	1,308	6.71	58,863
Right Channel Bank (Rt)	0.040	57.20	6.56	8.72	6,058	0.010	0.458	184	3.21	1,896
Maintenance Road at Toe	0.025	180.00	20.00	9.00	31,153	0.013	0.712	945	5.25	26,042
Right Levee Bank	0.030	81.00	20.12	4.02	6,832	0.018	0.421	207	2.56	1,356
Summation		1,380.71	162.07	8.52	189,563	0.645	18.316	5,750		171,598

Average Velocity	4.16	fps
Composite n (Conveyance)	0.030	
Composite n (Force)	0.063	
Composite n (Colbatch)	0.056	
α	1.72	

n used for freeboard eval.	0.060
n used for scour analysis	0.030

SCVWD Levee Recertification
Stevens Creek
Composite Roughness Calculations

Reach 5
Station 123+98 to Station 126+94

Channel Element	Elev	b	SS	n
Left Levee Bank			2	0.03
Maintenance Road at Toe	12.7	15		0.025
Left Channel Bank			1	0.035
Channel	10.7	60		0.025
Right Channel Bank			1.7	0.035
Maintenance Road at Toe	21.6	20		0.025
Right Levee Bank			2.5	0.03

Total Discharge	**5,750**	cfs
WSEL	**22.0**	feet

Element	n_i	A_i	P_i	R_i	$P_iR_i^{5/3}/n_i$	$P_in_i^2$	$A_in_i^{1.5}$	Q_i	V_i	$V_i^3A_i$
Left Bank	0.030	86.49	20.80	4.16	7,456	0.019	0.449	238	2.75	1,800
Maintenance Road at Toe	0.025	139.50	15.00	9.30	24,677	0.009	0.551	787	5.64	25,090
Left Channel Bank	0.035	20.60	2.83	7.28	2,211	0.003	0.135	71	3.43	828
Channel	0.025	678.00	60.00	11.30	136,566	0.038	2.680	4,358	6.43	180,034
Right Channel Bank	0.035	108.40	21.50	5.04	9,107	0.026	0.710	291	2.68	2,089
Maintenance Road at Toe	0.025	8.00	20.00	0.40	174	0.013	0.032	6	0.69	3
Right Levee Bank	0.030	0.20	1.08	0.19	2	0.001	0.001	0	0.35	0
Summation		1,041.19	141.20	7.37	180,193	0.109	4.558	5,750		209,844

Average Velocity	5.52	fps
Composite n (Conveyance)	0.022	
Composite n (Force)	0.028	
Composite n (Colbatch)	0.027	
α	1.20	

n used for freeboard eval.	0.030
n used for scour analysis	0.020

SCVWD Levee Recertification
Stevens Creek
Composite Roughness Calculations

Reach 6
Station 126+94 to Station 132+01

Channel Element	Elev	b	SS	n
Left Levee Bank			1.5	0.08
Channel	11.1	15		0.025
Right Channel Bank			1.7	0.035
Bench	17.2	55		0.045
Right Levee Bank			1.8	0.03

Total Discharge	**5,750**	cfs
WSEL	**24.0**	feet

Element	n_i	A_i	P_i	R_i	$P_iR_i^{5/3}/n_i$	$P_in_i^2$	$A_in_i^{1.5}$	Q_i	V_i	$V_i^3A_i$
Left Bank	0.080	124.81	23.26	5.37	4,782	0.149	2.824	298	2.39	1,703
Channel	0.025	193.50	15.00	12.90	42,573	0.009	0.765	2,655	13.72	499,876
Right Channel Bank	0.035	102.14	12.03	8.49	12,146	0.015	0.669	757	7.42	41,654
Bench	0.045	374.00	55.00	6.80	29,831	0.111	3.570	1,860	4.97	46,034
Right Levee Bank	0.030	41.62	14.00	2.97	2,868	0.013	0.216	179	4.30	3,303
Summation		836.07	119.29	7.01	92,199	0.297	8.044	5,750		592,569

Average Velocity	6.88	fps
Composite n (Conveyance)	0.033	
Composite n (Force)	0.050	
Composite n (Colbatch)	0.045	
α	2.18	

n used for freebard eval.	0.050
n used for scour analysis	0.035

SCVWD Levee Recertification
Stevens Creek
Composite Roughness Calculations

Reach 7
Station 132+01 to Station 141+37

Channel Element	Elev	b	SS	n
Left Levee Bank			1.2	0.1
Channel	17.6	20		0.025
Right Channel Bank			1.9	0.1
Bench	28.9	8		0.03
Right Levee Bank			4	0.065

Total Discharge	**5,750**	cfs
WSEL	**32.0**	feet

Element	n_i	A_i	P_i	R_i	$P_iR_i^{5/3}/n_i$	$P_in_i^2$	$A_in_i^{1.5}$	Q_i	V_i	$V_i^3A_i$
Left Bank	0.100	124.42	22.49	5.53	3,891	0.225	3.934	274	2.20	1,333
Channel	0.025	288.00	20.00	14.40	68,186	0.013	1.138	4,806	16.69	1,338,514
Right Channel Bank	0.100	187.86	24.26	7.74	7,353	0.243	5.941	518	2.76	3,944
Bench	0.030	24.80	8.00	3.10	1,758	0.007	0.129	124	5.00	3,091
Right Levee Bank	0.065	19.22	12.78	1.50	388	0.054	0.319	27	1.42	55
Summation		644.30	87.54	7.36	81,575	0.541	11.461	5,750		1,346,938

Average Velocity	8.92	fps
Composite n (Conveyance)	0.030	
Composite n (Force)	0.079	
Composite n (Colbatch)	0.068	
α	2.94	

n used for freeboard eval.	0.075
n used for scour analysis	0.030

SCVWD Levee Recertification
Stevens Creek
Composite Roughness Calculations

Reach 8
Station 141+37 to Station 142+13

Channel Element	Elev	b	SS	n
Left Levee Bank			1.2	0.1
Channel	21.5	30		0.04
Right Channel Bank			1.2	0.1
Bench	32	8		0.03
Right Levee Bank			0.01	0.015

Total Discharge	**5,750**	cfs
WSEL	**36.0**	feet

Element	n_i	A_i	P_i	R_i	$P_iR_i^{5/3}/n_i$	$P_in_i^2$	$A_in_i^{1.5}$	Q_i	V_i	$V_i^3A_i$
Left Bank	0.100	126.15	22.65	5.57	3,964	0.226	3.989	301	2.39	1,720
Channel	0.040	435.00	30.00	14.50	64,666	0.048	3.480	4,917	11.30	628,119
Right Channel Bank	0.100	116.55	16.40	7.11	4,308	0.164	3.686	328	2.81	2,587
Bench	0.030	32.00	8.00	4.00	2,688	0.007	0.166	204	6.39	8,335
Right Levee Bank	0.015	0.08	4.00	0.02	0	0.001	0.000	0	0.37	0
Summation		709.78	81.05	8.76	75,626	0.447	11.321	5,750		640,761

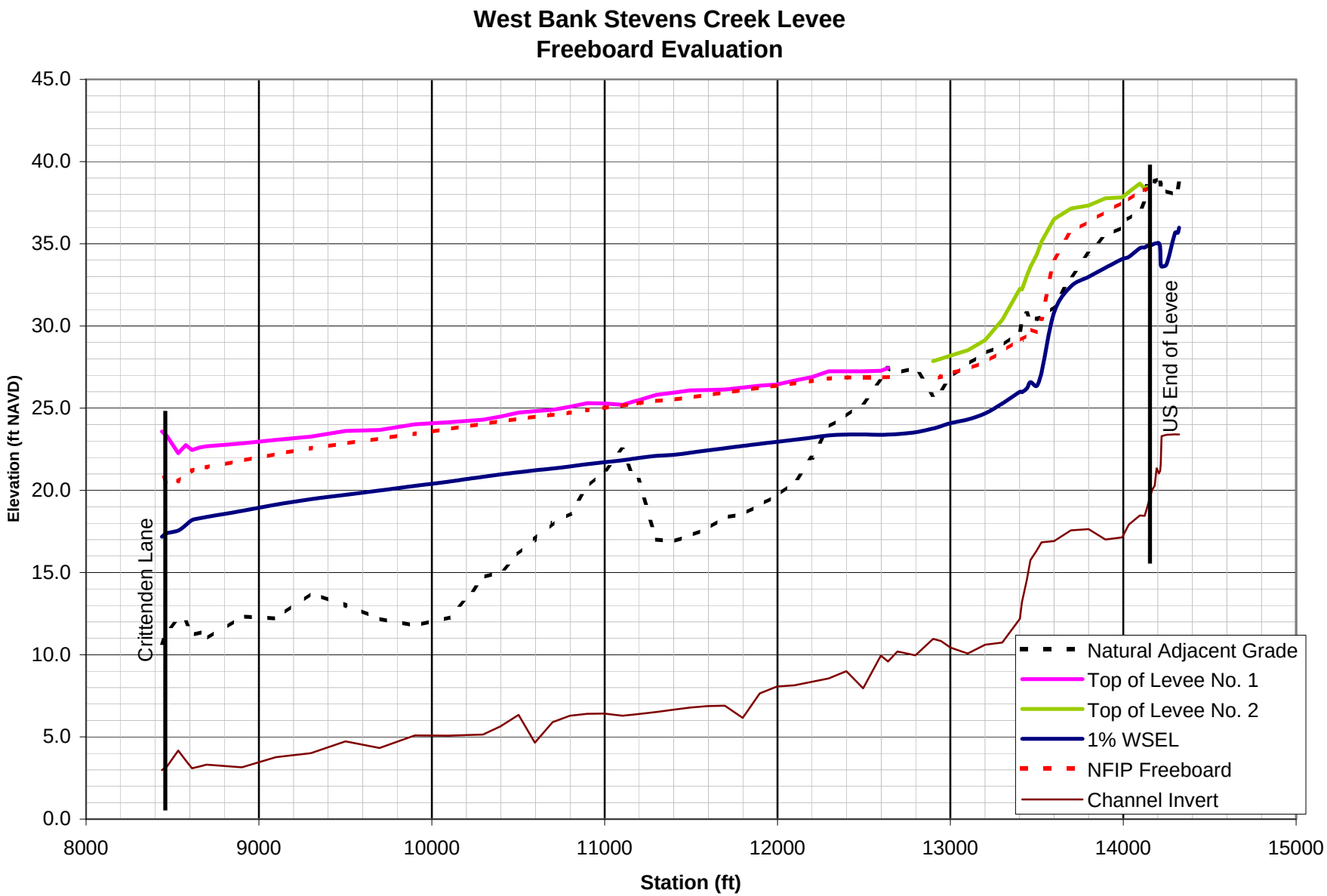
Average Velocity	8.10	fps
Composite n (Conveyance)	0.040	
Composite n (Force)	0.074	
Composite n (Colbatch)	0.063	
α	1.70	

n used for freeboard eval.	0.070
n used for scour analysis	0.040

Summary of Freeboard Evaluation for Stevens Creek West Bank Levee in Mountain View

River Station	Q Total (cfs)	Channel Invert (ft NAVD)	W.S. Elev (ft NAVD)	EGL (ft NAVD)	Avg Channel Velocity (ft/sec)	Froude No.	Top of West Levee (ft NAVD)	Natural Ground Elev. (ft NAVD)	Levee Condition?	Freeboard Reqd. for Certification (feet)	Reqd. Freeboard Elevation (ft NAVD)	Freeboard Provided (feet)	Certifiable?
Highway 101													
14323	5750	23.40	35.98	38.45	12.61	0.66	---	38.7	NO	0.00		2.69	---
14315	5750	23.40	35.66	38.41	13.30	0.71	---	38.4	NO	0.00		2.74	---
14300	5750	23.41	35.67	38.37	13.20	0.71	---	38.0	NO	0.00		2.33	---
14250	5750	23.38	33.75	38.10	16.72	1.01	---	38.2	NO	0.00		4.45	---
14222	5750	23.30	33.61	37.60	16.03	1.01	---	38.4	NO	0.00		4.79	---
14217	5750	21.58	33.74	37.42	15.40	0.96	---	38.6	NO	0.00		4.86	---
14213	5750	21.18	34.82	36.94	11.68	0.65	---	38.8	NO	0.00		3.98	---
14206	5750	21.03	35.04	36.66	10.22	0.55	---	39.0	NO	0.00		3.96	---
14193	5750	21.34	35.03	36.46	9.58	0.52	---	38.9	NO	0.00		3.87	---
14182	5750	20.28	35.01	36.30	9.09	0.54	---	38.8	NO	0.00		3.79	---
14168	5750	20.04	34.94	36.11	8.69	0.52	---	38.7	NO	0.00		3.76	---
14155	5750	19.61	34.90	35.95	8.22	0.49	---	38.6	NO	0.00		3.70	---
14137	5750	18.92	34.86	35.76	7.61	0.45	38.45	38.5	NO	3.50	38.36	3.59	YES
14124	5750	18.45	34.77	35.65	7.51	0.44	38.35	37.5	NO	3.49	38.26	3.58	YES
14096	5750	18.47	34.73	35.39	6.54	0.36	38.66	37.0	NO	3.48	38.21	3.93	YES
14032	5750	17.92	34.20	34.97	7.01	0.43	38.15	36.5	NO	3.46	37.66	3.95	YES
13994	5750	17.14	34.07	34.65	6.07	0.35	37.82	36.0	NO	3.44	37.51	3.75	YES
13897	5750	17.01	33.54	34.11	6.03	0.37	37.76	35.49	NO	3.40	36.94	4.22	YES
13800	5750	17.64	32.99	33.57	6.10	0.35	37.33	34.39	NO	3.36	36.35	4.34	YES
13697	5750	17.57	32.40	33.01	6.24	0.36	37.14	33.00	NO	3.32	35.72	4.74	YES
13600	5750	16.91	30.82	32.15	9.23	0.58	36.50	31.19	NO	3.28	34.10	5.68	YES
13527	5750	16.84	27.16	30.33	14.28	0.96	35.13	30.55	NO	3.25	30.41	7.97	YES
13500	5750	16.35	26.35	29.13	13.37	0.84	34.35	30.43	NO	3.24	29.59	8.00	YES
13463	5750	15.75	26.58	27.72	8.57	0.54	33.59	30.28	NO	3.23	29.81	7.01	YES
13443	5750	14.58	26.21	27.44	8.90	0.58	33.06	30.76	NO	3.22	29.43	6.85	YES
13414	5750	13.20	25.97	27.00	8.14	0.50	32.22	30.31	NO	3.21	29.18	6.25	YES
13402	5750	12.19	25.99	26.82	7.33	0.44	32.26	29.66	NO	3.20	29.19	6.27	YES
13300	5750	10.74	25.28	25.94	6.50	0.42	30.37	28.79	NO	3.16	28.44	5.09	YES
13201	5750	10.61	24.68	25.21	5.81	0.36	29.14	28.35	NO	3.12	27.80	4.46	YES
13100	5750	10.07	24.31	24.80	5.66	0.34	28.52	27.67	NO	3.08	27.39	4.21	YES
13001	5750	10.43	24.09	24.58	5.59	0.34	28.20	26.90	NO	3.04	27.13	4.11	YES
12945	5750	10.84	23.90	24.44	5.90	0.36	28.01	26.13	NO	3.02	26.92	4.11	YES
12912	5750	10.93	23.79	24.35	6.01	0.39	27.90	25.89	NO	3.00	26.79	4.11	YES
12900	5750	10.96	23.76	24.31	5.95	0.39	27.86	25.81	NO	3.00	26.76	4.10	YES
12798	5750	9.96	23.53	24.04	5.69	0.33	---	27.44	NO	0.00		3.91	---
12694	5750	10.20	23.42	23.82	5.11	0.29	---	27.16	NO	0.00		3.74	---
12639	5750	9.59	23.39	23.75	4.82	0.27	27.44	27.44	NO	3.50	26.89	4.05	YES
12598	5750	9.95	23.38	23.73	4.74	0.28	27.27	26.65	NO	3.50	26.88	3.89	YES
12495	5750	7.96	23.40	23.66	4.02	0.22	27.24	25.34	NO	3.48	26.88	3.84	YES
12398	5750	9.00	23.39	23.62	3.90	0.21	27.24	24.50	NO	3.47	26.86	3.85	YES
12296	5750	8.56	23.34	23.57	3.92	0.21	27.24	23.86	NO	3.46	26.80	3.90	YES
12199	5750	8.35	23.21	23.45	3.98	0.22	26.89	21.98	YES	3.45	26.66	3.68	YES
12098	5750	8.14	23.08	23.32	3.99	0.22	26.68	20.50	YES	3.44	26.52	3.60	YES
11997	5750	8.07	22.95	23.20	3.98	0.22	26.44	19.67	YES	3.42	26.37	3.49	YES
11897	5750	7.65	22.83	23.07	3.97	0.22	26.37	19.12	YES	3.41	26.24	3.54	YES
11799	5750	6.16	22.70	22.94	3.98	0.22	26.25	18.54	YES	3.40	26.10	3.55	YES
11695	5750	6.90	22.56	22.81	3.99	0.22	26.13	18.36	YES	3.39	25.95	3.57	YES
11596	5750	6.88	22.43	22.69	4.06	0.22	26.10	17.68	YES	3.38	25.81	3.67	YES
11496	5750	6.79	22.29	22.55	4.09	0.22	26.08	17.25	YES	3.36	25.65	3.79	YES
11398	5750	6.66	22.16	22.42	4.07	0.22	25.94	16.89	YES	3.35	25.51	3.78	YES
11299	5750	6.52	22.10	22.29	3.44	0.19	25.81	17.01	YES	3.34	25.44	3.71	YES
11196	5750	6.39	21.97	22.19	3.64	0.20	25.48	20.63	YES	3.33	25.30	3.51	YES
11170	5750	6.36	21.93	22.16	3.88	0.22	25.41	20.71	YES	3.33	25.26	3.48	YES
11103	5750	6.29	21.83	22.07	3.96	0.22	25.20	22.48	NO	3.32	25.15	3.37	YES
10998	5750	6.42	21.71	21.93	3.80	0.21	25.29	21.18	YES	3.30	25.01	3.58	YES
10899	5750	6.41	21.59	21.81	3.83	0.21	25.30	20.19	YES	3.29	24.88	3.71	YES
10799	5750	6.29	21.45	21.69	3.91	0.22	25.08	18.58	YES	3.28	24.73	3.63	YES
10699	5750	5.90	21.33	21.56	3.89	0.22	24.90	18.01	YES	3.27	24.60	3.57	YES
10596	5750	4.65	21.22	21.43	3.68	0.20	24.82	17.03	YES	3.26	24.48	3.60	YES
10502	5750	6.34	21.10	21.33	3.82	0.21	24.73	16.13	YES	3.25	24.35	3.63	YES
10397	5750	5.64	20.97	21.20	3.86	0.22	24.49	15.02	YES	3.23	24.20	3.52	YES
10296	5750	5.14	20.82	21.07	3.95	0.22	24.30	14.71	YES	3.22	24.04	3.48	YES
10203	5750	5.11	20.69	20.93	3.99	0.23	24.22	13.38	YES	3.21	23.90	3.53	YES
10097	5750	5.08	20.53	20.78	4.00	0.23	24.14	12.26	YES	3.20	23.73	3.61	YES
9902	5750	5.09	20.27	20.50	3.85	0.22	24.02	11.77	YES	3.17	23.44	3.75	YES
9698	5750	4.33	19.99	20.22	3.84	0.22	23.67	12.19	YES	3.15	23.14	3.68	YES
9501	5750	4.73	19.73	19.96	3.85	0.22	23.61	13.01	YES	3.13	22.86	3.88	YES
9300	5838	4.01	19.46	19.69	3.86	0.22	23.27	13.74	YES	3.10	22.56	3.81	YES
9098	5838	3.77	19.13	19.38	3.97	0.23	23.07	12.20	YES	3.08	22.21	3.94	YES
8901	5838	3.15	18.75	19.01	4.10	0.24	22.86	12.33	YES	3.06	21.81	4.11	YES
8697	5838	3.31	18.38	18.62	3.98	0.23	22.68	10.96	YES	3.03	21.41	4.30	YES
8657	5838	3.20	18.30	18.55	4.04	0.24	22.61	11.35	YES	3.03	21.33	4.31	YES
8613	5838	3.09	18.19	18.46	4.20	0.25	22.45	11.20	YES	3.02	21.21	4.26	YES
8577	5838	3.56	17.89	18.34	5.43	0.36	22.75	11.97	YES	3.02	20.91	4.86	YES
8533	5838	4.17	17.55	18.13	6.07	0.38	22.26	12.13	YES	3.01	20.56	4.71	YES
8467	5838	3.18	17.39	17.91	5.76	0.34	23.32	11.43	YES	3.00	20.39	5.93	YES
8439	5838	2.98	17.18	17.83	6.49	0.38	23.58	10.71	YES	4.00	21.18	6.40	YES
Crittenden Lane													

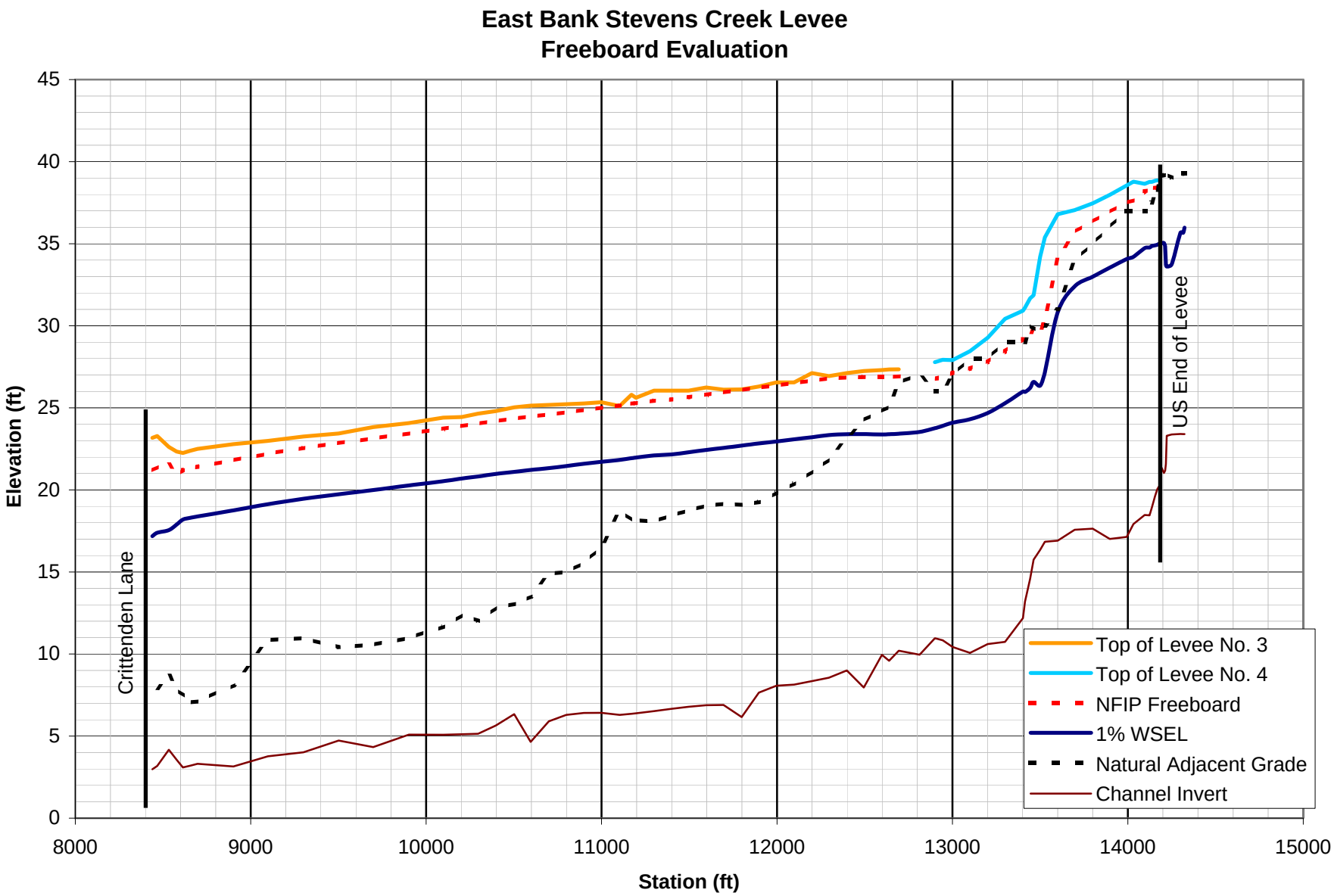
Levee System No. 1
Levee System No. 2


West Bank Stevens Creek Levee
Freeboard Evaluation
Elevation (ft NAVD)
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
8000
9000
10000
11000
12000
13000
14000
15000
Station (ft)
Crittenden Lane
US End of Levee
Natural Adjacent Grade
Top of Levee No. 1
Top of Levee No. 2
1% WSEL
NFIP Freeboard
Channel Invert

Summary of Freeboard Evaluation for Stevens Creek East Bank Levee in Mountain View

River Station	Q Total	Channel Invert	W.S. Elev	EGL	Avg. Channel Velocity	Froude No.	Top of East Levee/FW	Natural Ground Elev.	Levee Condition?	Freeboard Reqd. for Certification	Reqd. Freeboard Elevation	Freeboard Provided	Certifiable?
	(cfs)	(ft NAVD)	(ft NAVD)	(ft NAVD)	(ft/sec)		(ft NAVD)	(ft NAVD)		(feet)	(ft NAVD)	(feet)	
Highway 101													
14323	5750	23.40	35.98	38.45	12.61	0.66	---	39.27	NO	0.00		3.29	---
14315	5750	23.40	35.66	38.41	13.30	0.71	---	39.27	NO	0.00		3.61	---
14300	5750	23.41	35.67	38.37	13.20	0.71	---	39.20	NO	0.00		3.53	---
14250	5750	23.38	33.75	38.10	16.72	1.01	---	39.02	NO	0.00		5.27	---
14222	5750	23.30	33.61	37.60	16.03	1.01	---	39.22	NO	0.00		5.61	---
14217	5750	21.58	33.74	37.42	15.40	0.96	---	39.22	NO	0.00		5.48	---
14213	5750	21.18	34.82	36.94	11.68	0.65	---	39.20	NO	0.00		4.38	---
14206	5750	21.03	35.04	36.66	10.22	0.55	---	39.18	NO	0.00		4.14	---
14193	5750	21.34	35.03	36.46	9.58	0.52	---	39.11	NO	0.00		4.08	---
14182	5750	20.28	35.01	36.30	9.09	0.54	---	39.07	NO	0.00		4.06	---
14168	5750	20.04	34.94	36.11	8.69	0.52	38.86	38	NO	3.50	38.44	3.92	YES
14155	5750	19.61	34.90	35.95	8.22	0.49	38.83	38	NO	3.49	38.39	3.93	YES
14137	5750	18.92	34.86	35.76	7.61	0.45	38.77	38	NO	3.49	38.35	3.91	YES
14124	5750	18.45	34.77	35.65	7.51	0.44	38.77	37	NO	3.48	38.25	4.00	YES
14096	5750	18.47	34.73	35.39	6.54	0.36	38.65	37	NO	3.47	38.20	3.92	YES
14032	5750	17.92	34.20	34.97	7.01	0.43	38.78	37	NO	3.45	37.65	4.58	YES
13994	5750	17.14	34.07	34.65	6.07	0.35	38.55	37	NO	3.43	37.50	4.48	YES
13897	5750	17.01	33.54	34.11	6.03	0.37	37.98	36	NO	3.39	36.93	4.44	YES
13800	5750	17.64	32.99	33.57	6.10	0.35	37.46	35	NO	3.35	36.34	4.47	YES
13697	5750	17.57	32.40	33.01	6.24	0.36	37.05	34	NO	3.31	35.71	4.65	YES
13600	5750	16.91	30.82	32.15	9.23	0.58	36.80	31	NO	3.28	34.10	5.98	YES
13527	5750	16.84	27.16	30.33	14.28	0.96	35.39	30	NO	3.25	30.41	8.23	YES
13500	5750	16.35	26.35	29.13	13.37	0.84	34.21	30	NO	3.24	29.59	7.86	YES
13463	5750	15.75	26.58	27.72	8.57	0.54	31.86	30	NO	3.22	29.80	5.28	YES
13443	5750	14.58	26.21	27.44	8.90	0.58	31.67	30	NO	3.21	29.42	5.46	YES
13414	5750	13.20	25.97	27.00	8.14	0.50	31.11	29	NO	3.20	29.17	5.14	YES
13402	5750	12.19	25.99	26.82	7.33	0.44	30.92	29	NO	3.20	29.19	4.93	YES
13300	5750	10.74	25.28	25.94	6.50	0.42	30.42	29	NO	3.16	28.44	5.14	YES
13201	5750	10.61	24.68	25.21	5.81	0.36	29.27	28	NO	3.12	27.80	4.59	YES
13100	5750	10.07	24.31	24.80	5.66	0.34	28.45	28	NO	3.08	27.39	4.14	YES
13001	5750	10.43	24.09	24.58	5.59	0.34	27.91	27	NO	3.04	27.13	3.82	YES
12945	5750	10.84	23.90	24.44	5.90	0.36	27.93	26	NO	3.02	26.92	4.03	YES
12912	5750	10.93	23.79	24.35	6.01	0.39	27.82	26	NO	3.00	26.79	4.03	YES
12900	5750	10.96	23.76	24.31	5.95	0.39	27.78	26	NO	3.00	26.76	4.02	YES
12813	5750	9.96	23.53	24.04	5.69	0.33	---	27.02	NO	0.00		3.49	---
12694	5750	10.20	23.42	23.82	5.11	0.29	27.35	26.54	NO	3.50	26.92	3.93	YES
12639	5750	9.59	23.39	23.75	4.82	0.27	27.34	25.07	NO	3.49	26.88	3.95	YES
12598	5750	9.95	23.38	23.73	4.74	0.28	27.30	24.80	NO	3.49	26.87	3.92	YES
12495	5750	7.96	23.40	23.66	4.02	0.22	27.24	24.25	NO	3.48	26.88	3.84	YES
12398	5750	9.00	23.39	23.62	3.90	0.21	27.12	23.17	YES	3.47	26.86	3.73	YES
12296	5750	8.56	23.34	23.57	3.92	0.21	26.93	21.86	YES	3.45	26.79	3.59	YES
12199	5750	8.35	23.21	23.45	3.98	0.22	27.12	21.12	YES	3.44	26.65	3.91	YES
12098	5750	8.14	23.08	23.32	3.99	0.22	26.55	20.40	YES	3.43	26.51	3.47	YES
11997	5750	8.07	22.95	23.20	3.98	0.22	26.55	19.83	YES	3.42	26.37	3.60	YES
11897	5750	7.65	22.83	23.07	3.97	0.22	26.30	19.26	YES	3.41	26.24	3.47	YES
11799	5750	6.16	22.70	22.94	3.98	0.22	26.12	19.09	YES	3.39	26.09	3.42	YES
11695	5750	6.90	22.56	22.81	3.99	0.22	26.11	19.15	YES	3.38	25.94	3.55	YES
11596	5750	6.88	22.43	22.69	4.06	0.22	26.24	19.04	YES	3.37	25.80	3.81	YES
11496	5750	6.79	22.29	22.55	4.09	0.22	26.05	18.75	YES	3.36	25.65	3.76	YES
11398	5750	6.66	22.16	22.42	4.07	0.22	26.05	18.44	YES	3.35	25.51	3.89	YES
11299	5750	6.52	22.10	22.29	3.44	0.19	26.05	18.08	YES	3.34	25.44	3.95	YES
11196	5750	6.39	21.97	22.19	3.64	0.20	25.61	18.15	YES	3.32	25.29	3.64	YES
11170	5750	6.36	21.93	22.16	3.88	0.22	25.80	18.16	YES	3.32	25.25	3.87	YES
11103	5750	6.29	21.83	22.07	3.96	0.22	25.11	18.72	YES	3.31	25.14	3.28	NO
10998	5750	6.42	21.71	21.93	3.80	0.21	25.34	16.52	YES	3.30	25.01	3.63	YES
10899	5750	6.41	21.59	21.81	3.83	0.21	25.27	15.56	YES	3.29	24.88	3.68	YES
10799	5750	6.29	21.45	21.69	3.91	0.22	25.22	15.00	YES	3.28	24.73	3.77	YES
10699	5750	5.90	21.33	21.56	3.89	0.22	25.18	14.89	YES	3.27	24.60	3.85	YES
10596	5750	4.65	21.22	21.43	3.68	0.20	25.13	13.51	YES	3.25	24.47	3.91	YES
10502	5750	6.34	21.10	21.33	3.82	0.21	25.03	13.05	YES	3.24	24.34	3.93	YES
10397	5750	5.64	20.97	21.20	3.86	0.22	24.80	12.83	YES	3.23	24.20	3.83	YES
10296	5750	5.14	20.82	21.07	3.95	0.22	24.65	12.02	YES	3.22	24.04	3.83	YES
10203	5750	5.11	20.69	20.93	3.99	0.23	24.44	12.37	YES	3.21	23.90	3.75	YES
10097	5750	5.08	20.53	20.78	4.00	0.23	24.40	11.67	YES	3.19	23.72	3.87	YES
9902	5750	5.09	20.27	20.50	3.85	0.22	24.07	10.98	YES	3.17	23.44	3.80	YES
9698	5750	4.33	19.99	20.22	3.84	0.22	23.83	10.57	YES	3.15	23.14	3.84	YES
9501	5750	4.73	19.73	19.96	3.85	0.22	23.44	10.42	YES	3.12	22.85	3.71	YES
9300	5838	4.01	19.46	19.69	3.86	0.22	23.25	10.96	YES	3.10	22.56	3.79	YES
9098	5838	3.77	19.13	19.38	3.97	0.23	22.99	10.85	YES	3.08	22.21	3.86	YES
8901	5838	3.15	18.75	19.01	4.10	0.24	22.79	8.10	YES	3.05	21.80	4.04	YES
8697	5838	3.31	18.38	18.62	3.98	0.23	22.50	7.11	YES	3.03	21.41	4.12	YES
8657	5838	3.20	18.30	18.55	4.04	0.24	22.39	7.05	YES	3.03	21.33	4.09	YES
8613	5838	3.09	18.19	18.46	4.20	0.25	22.25	7.48	YES	3.02	21.21	4.06	YES
8577	5838	3.56	17.89	18.34	5.43	0.36	22.34	7.84	YES	3.02	20.91	4.45	YES
8533	5838	4.17	17.55	18.13	6.07	0.38	22.62	8.76	YES	4.00	21.55	5.07	YES
8467	5838	3.18	17.39	17.91	5.76	0.34	23.28	7.93	YES	4.00	21.39	5.89	YES
8439	5838	2.98	17.18	17.83	6.49	0.38	23.17	7.73	YES	4.00	21.18	5.99	YES
Crittenden Lane													

Levee System No. 3
Levee System No. 4


East Bank Stevens Creek Levee
Freeboard Evaluation
Elevation (ft)
Station (ft)
45
40
35
30
25
20
15
10
5
0
8000
9000
10000
11000
12000
13000
14000
15000
Crittenden Lane
US End of Levee
Top of Levee No. 3
Top of Levee No. 4
NFIP Freeboard
1% WSEL
Natural Adjacent Grade
Channel Invert

TAB 7

Schaaf & Wheeler
CONSULTING CIVIL ENGINEERS

100 N. Winchester Blvd., Suite 200
Santa Clara, CA 95050
(408) 246-4848
FAX (408) 246-5624
canderson@swsv.com

TECHNICAL MEMORANDUM

PROJECT:	Recertification of Provisionally Accredited Levees P141 and P143 in Mountain View, California	DATE:	May 8, 2009
PREPARED:	Charles D. Anderson, PE	JOB #:	SCVW.18.08-002B3
SUBJECT:	Evaluation of Structural Stability for East Bank Levee Floodwall		

The East Bank Levee of Stevens Creek (Provisionally Accredited Levee P143) has a monolithic concrete floodwall from River Stations 126+94 to 111+70. Floodwall details are provided on Sheet 18 of the record drawings (Tab 5). A floodwall profile is also provided, and shows varying wall and foundation elevations from levee "P" stations 126+71 to 142+35.

AMEC Geomatrix addresses the global geotechnical stability of the levee and floodwall system in Section 7.4.5 of their Geotechnical Investigation (enclosed). They find that "...the concrete flood wall will be stable under flood condition from the geotechnical perspective. [They] did not evaluate the structural integrity or design of the flood wall."

The purpose of this memorandum is to ***evaluate the structural integrity and design of the flood wall.***

Structural Loading Cases

The following loading cases described in FEMA 114 are considered:

1. Dead and Wind
2. Dead and Flood
3. Dead and Seismic

The floodwall does not support any additional earth load, so the earth loading cases are not applicable. AMEC Geomatrix has estimated a soil passive resistance factor of safety of 2.2 for the flooding condition using the computer program CWALSHT. The floodwall is further evaluated for stability and structural reinforcement for the above-listed loading conditions using the original design documents titled "Geotechnical Investigation: Proposed Stevens Creek Flood Control Improvements; Central Expressway to San Francisco Bay," (Berloger and Associates, 1981) The design soil pressure diagram is attached. It may also be noted that the maximum allowable design bearing pressure for the floodwall foundation is 2,500 pounds per square foot (psf).

Dead and Wind Loads

USACE EM 1110-2-2502 recommends a wind pressure of 30 psf in areas not subject to hurricane force winds. As shown in the static force diagram of Figure 1, the most critical loading case is without any soil saturation to counterbalance the wind pressure. Table 1 presents a summary of the overturning moment and sliding force (wind pressure), the resisting moment and force (dead weight and passive soil pressure), and factors of safety for the various wall segments. (The resistance of dead weight friction on the foundation bottom is neglected.) Each wall segment exceeds the required minimum 1.5 factor of safety.

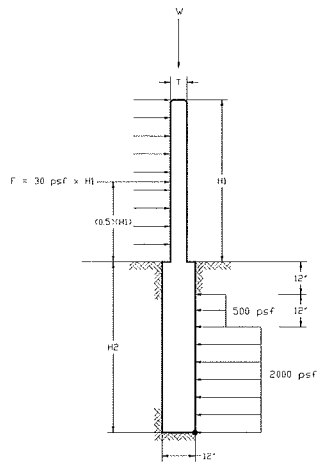


Figure 1. Dead plus Wind Loading Diagram

Table 1
Floodwall Stability Analysis for Dead and Wind Loads

Wind Pressure	30	psf per EM 1110-2-2502
Concrete Weight	150	pcf
Footing Width	12	inches
Passive (top foot)	500	psf
Passive (remainder)	2000	psf
Allowable Bearing	2500	psf

Station						Overturning Moment			Sliding		
From	To	H1 (feet)	H2 (feet)	t (inches)	W / Bearing (psf)	Moment (ft-lb)	Resistance (ft-lb)	FS	Active (pounds)	Resisting (pounds)	FS
126+71	127+87	3.00	3.58	6	762	457	3917	8.6	90	3660	40.7
127+87	129+40	4.00	4.58	6	987	790	8690	11.0	120	5660	47.2
129+40	130+30	5.00	5.25	6	1163	1163	13019	11.2	150	7000	46.7
130+30	131+97	6.00	6.58	9	1662	1724	24347	14.1	180	9660	53.7
131+97	133+50	7.00	7.58	9	1925	2327	35139	15.1	210	11660	55.5
133+50	134+70	7.00	9.33	9	2187	2694	58737	21.8	210	15160	72.2
134+70	142+35	8.00	8.42	9	2163	2981	45758	15.4	240	13340	55.6

Dead and Flood Loads

Minimum certifiable freeboard of 3 feet from the top of wall is assumed to establish the base flood elevation for each wall segment. Based on AMEC Geomatrix's steady-state seepage analysis for flooded conditions, the land-side groundwater level is about 3 feet below the top of levee. A linear transition is assumed for uplift pressure on the bottom of the floodwall foundation. A static force diagram is presented in Figure 2 and Table 2 presents a summary of the overturning moment and sliding force (hydrostatic pressure including uplift), the resisting moment and force (dead weight, passive soil pressure and groundwater pressure), and factors of safety for the various wall segments. (The resistance of dead weight friction on the foundation bottom is neglected.) Each wall segment exceeds the required minimum 1.5 factor of safety.

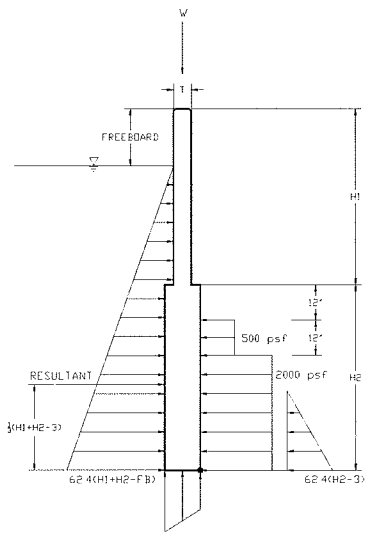


Figure 2. Dead plus Flood Loading Diagram

Table 2
Floodwall Stability Analysis for Dead and Flood Loads

Flood Elevation	3	feet from top of wall
Groundwater Elev.	3	feet from ground
Water Pressure	62.4	psf/ft
Concrete Weight	150	pcf
Footing Width	12	inches
Passive (top foot)	500	psf
Passive (remainder)	2000	psf
Allowable Bearing	2500	psf

Station						Overturning			Sliding		
From	To	H1 (feet)	H2 (feet)	t (inches)	W / Bearing (psf)	Moment (ft-lb)	Resistance (ft-lb)	FS	Active (pounds)	Resisting (pounds)	FS
126+71	127+87	3.00	3.58	6	762	620	3917	6.3	400	3670	9.2
127+87	129+40	4.00	4.58	6	987	2023	8690	4.3	971	5738	5.9
129+40	130+30	5.00	5.25	6	1163	4241	13019	3.1	1640	7158	4.4
130+30	131+97	6.00	6.58	9	1662	9505	24347	2.6	2863	10060	3.5
131+97	133+50	7.00	7.58	9	1925	16584	35139	2.1	4184	12314	2.9
133+50	134+70	7.00	9.33	9	2187	25122	58737	2.3	5544	16410	3.0
134+70	142+35	8.00	8.42	9	2163	25638	47414	1.8	5619	14257	2.5

Dead and Seismic Loads

According to AMEC Geomatrix, the peak ground acceleration for a 475-year return period is 0.48g (Geotechnical Investigation, page 27). A static force diagram is presented in Figure 3 and Table 3 presents a summary of the overturning moment and sliding force (hydrostatic pressure including uplift), the resisting moment and force (dead weight and passive soil pressure), and factors of safety for the various wall segments. (The resistance of dead weight friction on the foundation bottom is neglected.) Each wall segment exceeds the required minimum 1.3 factor of safety.

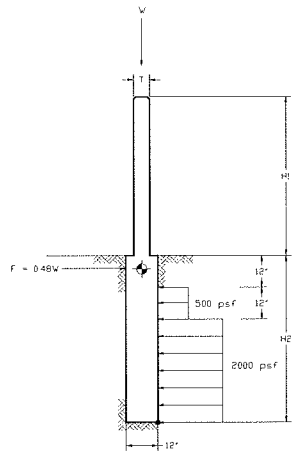


Figure 3. Dead plus Seismic Loading Diagram

Table 3
Floodwall Stability Analysis for Dead and Seismic Loads

Peak Ground Accel	0.48	g per AMEC Geomatrix
Concrete Weight	150	pcf
Footing Width	12	inches
Passive (top foot)	500	psf
Passive (remainder)	2000	psf
Allowable Bearing	2500	psf

Station						Dist. To	Overturning Moment			Sliding		
From	To	H1 (feet)	H2 (feet)	t (inches)	W / Bearing (psf)	Centroid (ft)	Moment (ft-lb)	Resistance (ft-lb)	FS	Active (pounds)	Resisting (pounds)	FS
126+71	127+87	3.00	3.58	6	762	2.76	1010	3917	3.9	366	3660	10.0
127+87	129+40	4.00	4.58	6	987	3.59	1703	8690	5.1	474	5660	11.9
129+40	130+30	5.00	5.25	6	1163	4.28	2387	13019	5.5	558	7000	12.5
130+30	131+97	6.00	6.58	9	1662	5.84	4663	24347	5.2	798	9660	12.1
131+97	133+50	7.00	7.58	9	1925	6.77	6257	35139	5.6	924	11660	12.6
133+50	134+70	7.00	9.33	9	2187	7.61	7984	58737	7.4	1050	15160	14.4
134+70	142+35	8.00	8.42	9	2163	7.63	7918	45758	5.8	1038	13340	12.8

Steel Reinforcement

The dead plus flood loading condition is the most extreme of the three loading conditions examined. AMEC Geomatrix estimates a maximum bending moment in the wall under flood conditions with steady-state seepage of 2,812 foot-pounds. Using ultimate strength design, the factored moment for bending is (1.4)(2,812 ft-lb) or 3,940 ft-lb. Main reinforcing steel is #6 at 12" on center with 2.5 inches of cover within the 9-inch thick wall.

Using the ACI code and conservatively assuming 36 ksi steel reinforcement and 3,000 psi concrete:

$$a = \frac{A_{st}\, f_y}{0.85\, f_c^{'}\, b} = \frac{(0.44)(36{,}000)}{(0.85)(3{,}000)(12)} = 0.52\, inch$$

$$M_n = A_{st}\, f_y \left(d - \frac{1}{2} a \right) = (0.44\, in^2)(36{,}000\, psi)\left(6'' - 0.5(0.52'')\right) = 7{,}580\, ft - lb$$

Using the strength reduction factor of 0.90 for flexure,

$\Phi M_n = (0.9)(7{,}580) = 6{,}820$ ft-lb > 3,940 ft-lb

The wall is adequately reinforced.

TA705.3S84G4 1981 c.2

GEOTECHNICAL INVESTIGATION
PROPOSED STEVENS CREEK FLOOD CONTROL IMPROVEMENTS
CENTRAL EXPRESSWAY TO SAN FRANCISCO BAY
SANTA CLARA COUNTY, CALIFORNIA
FOR
SANTA CLARA VALLEY WATER DISTRICT

December 8, 1981

Job No. 915-40

It is our opinion that the existing piers can be used for support of the new raised bridge provided the allowable load does not exceed 80 kips per pier. In addition, based on our analysis and elevations shown on the as-built plans and present profile, we recommend the following lateral pressures:

1. Passive Pressure 2000 psf (rectangular distribution)
   a. Abutment - Use below area with at least five feet of horizontal confinement (about elevation 4 feet M.S.L.)
   b. Pier - Use below elevation 0.0 feet M.S.L.
2. Active Pressure 90 pcf (equivalent fluid)

Floodwalls

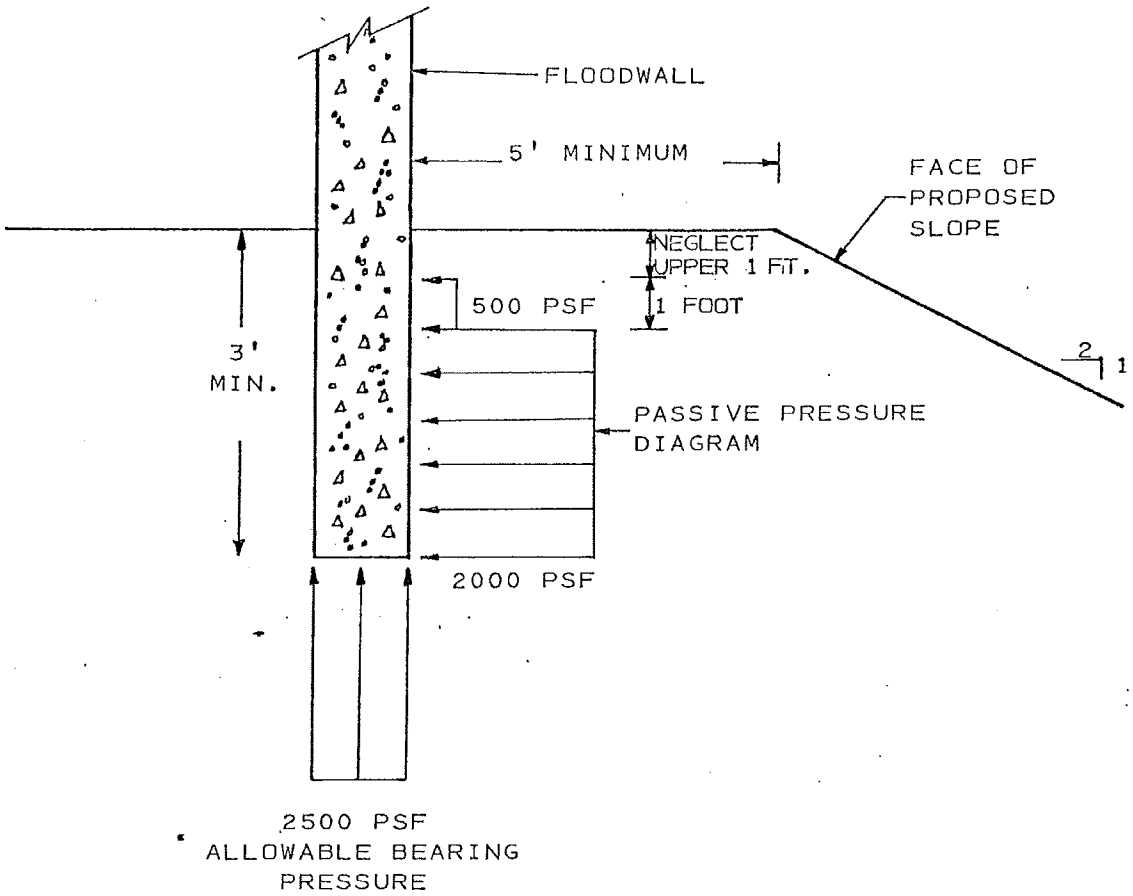
A floodwall is presently proposed for this project and is to be located on the east bank along U.S. Government land (station 126+70 to 142+35). The walls will be from 2 to 8 feet in height.

Our exploration indicates the floodwall foundation soil will consist of highly expansive silty clay. To mitigate the adverse effects on the floodwall (tilting, heaving, etc.), we recommend the floodwall foundation consist of a continuous cast-in-place concrete footing. Design criteria for the foundation is presented on Plate 10. The proposed 12 inch wide footing excavation (maximum depth is 8 feet) should not, in our opinion, experience significant caving, provided that the elapsed time between excavation and concrete placement does not exceed 1 to 2 days. The possibility of encountered localized areas of unstable trench walls cannot be ruled out. Equipment and surcharge loads should be avoided within 10 feet of the trench.

Bypass Pipe/Box Culvert

A 200 foot long, 12 foot diameter bypass pipe line or alternatively a box culvert are being considered from approximately station 103+00 to 105+00, just south of the Bayshore Freeway. At the time of our field exploration, plans showed a pipeline located along the west bank; we now understand that an east bank alignment is being considered. Pacific Gas & Electric transmission towers are located on both sides of the channel and a gas line crosses the channel at this location. We understand the gas line will be relocated.

The west bank contains about 4 feet of stiff silty clay fill which is underlain by stiff to very stiff silty clay. After our field exploration we observed an open 4 feet deep PG&E trench on the east bank along the gas line alignment. The vertical trench walls consisted of silty sandy gravel fill materials. Since the fill was not explored in depth, no conclusions can be given as to its stability in deep excavations. Groundwater was encountered at a depth of 17 feet below the west bank ground surface. We consider the natural subsurface conditions favorable for cut and cover



NOT TO SCALE

RECOMMENDATIONS

FOR

FLOODWALL FOUNDATION

NOTES:

1. CONCRETE FOR FOOTINGS SHOULD BE PLACED AGAINST UNDISTURBED SOIL OR PROPERLY COMPACTED BACKFILL.
2. PASSIVE PRESSURES SHOULD BE NEGLECTED IN THE TOP FOOT. PASSIVE PRESSURE SHOULD ALSO BE NEGLECTED WHERE THERE IS LESS THAN 5 FEET OF HORIZONTAL CONFINEMENT BETWEEN THE FOUNDATION AND THE FACE OF SLOPE.
3. ACTIVE PRESSURE SHOULD BE CONSIDERED EQUAL TO AN EQUIVALENT FLUID OF 90 POUNDS PER CUBIC FEET. THIS IS TO BE USED AT THE ENDS OF THE RETAINING WALL WHERE FILL WILL BE PLACED AGAINST THE INSIDE CHANNEL WALL.

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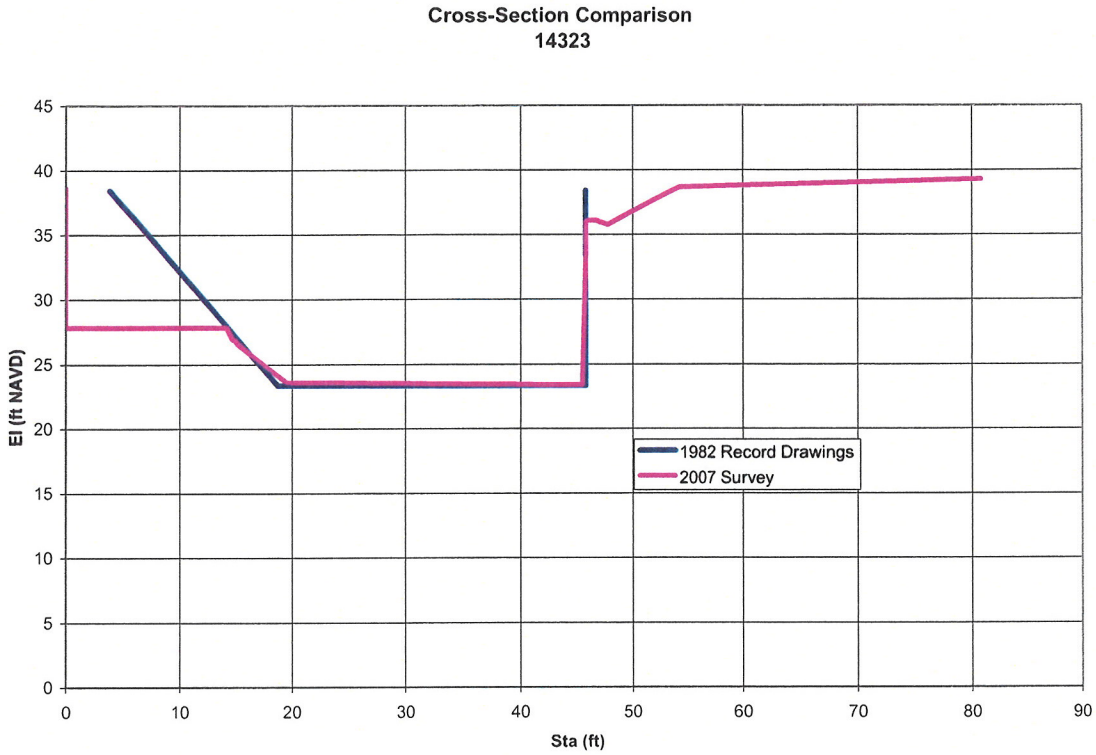
canderson@swsv.com

TECHNICAL MEMORANDUM

PROJECT:	Recertification of Provisionally Accredited Levees P141 and P143 in Mountain View, California	DATE:	May 11, 2009
PREPARED:	Charles D. Anderson, PE	JOB #:	SCVW.18.08-002B3
SUBJECT:	Sediment Transport Considerations for Stevens Creek		

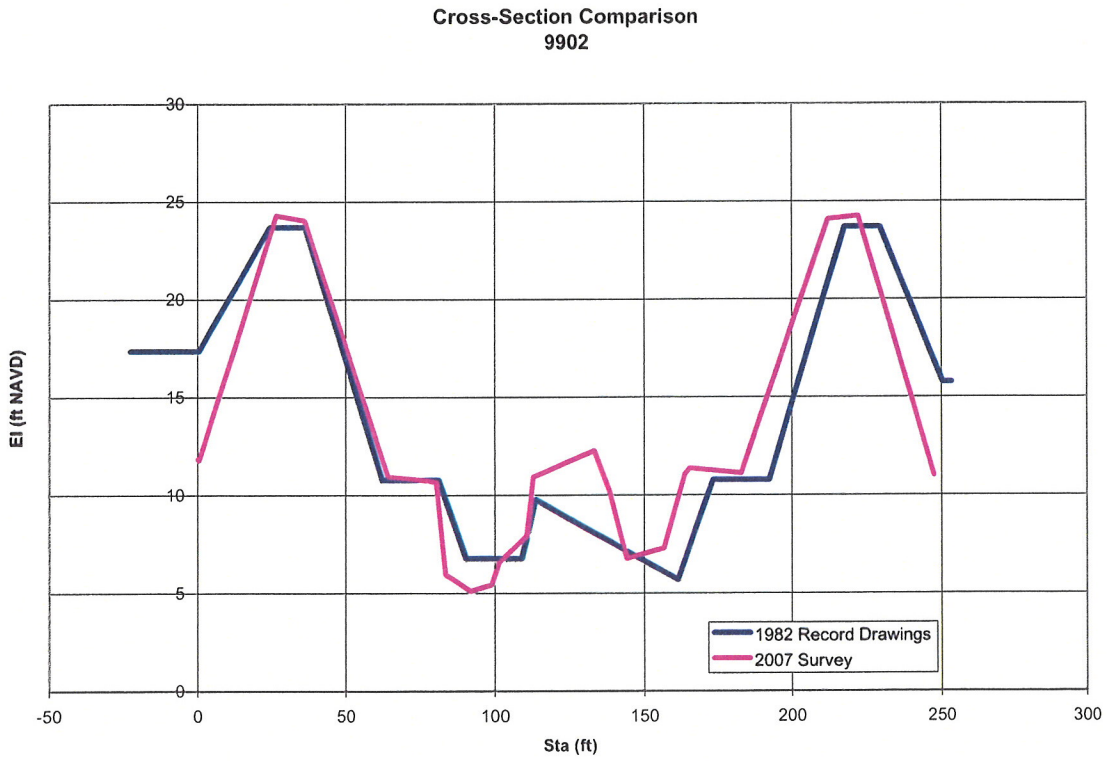
Based on record surveys and experience with past flood events, the bed and banks of Stevens Creek appear to be relatively stable. For example there is no record of any significant erosional damage caused by the storm event of early February 1998, which had an estimated regional return-period of about 80 years based on local streamflow records. The levee slopes generally consist of clayey soils that are well vegetated with grasses and other vegetation and are expected to be resistant to erosion, which could be a source of downstream sediment deposition. Sediment aggradation does occur toward the downstream end of the creek near San Francisco Bay, but the source of this aggradation is generally fine marine sediments brought in suspension on daily tide cycles. This deposition is not expected to affect hydraulics during a major storm event. Accumulated sediment is routinely removed in accordance with the District's Stream Maintenance Program (Tab 9). Sediment removal records for the most recent fiscal year are attached to this memorandum.

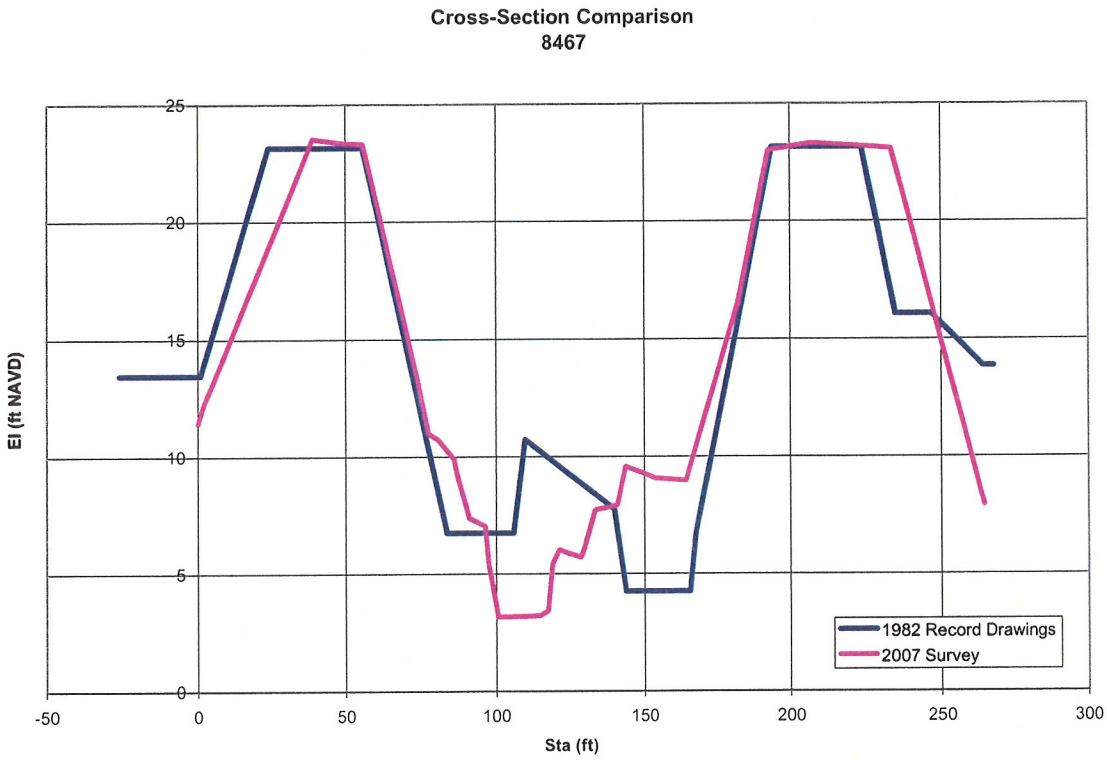
A comparison of several creek cross sections from the 1982 record drawings against the same sections field surveyed in 2007 reveals the relative stream bed stability over 25 years, which include the flood of record in 1998. The 1982 record drawings are on the NGVD29 vertical datum and have been adjusted to the NAVD88 datum for comparison.


Cross-Section Comparison
14323
El (ft NAVD)
Sta (ft)
1982 Record Drawings
2007 Survey
0
5
10
15
20
25
30
35
40
45
0
10
20
30
40
50
60
70
80
90

Cross-Section Comparison
12398
El (ft NAVD)
Sta (ft)
1982 Record Drawings
2007 Survey
0
5
10
15
20
25
30
-50
0
50
100
150
200

Cross-Section Comparison
11680
El (ft NAVD)
Sta (ft)
1982 Record Drawings
2007 Survey
30
25
20
15
10
5
0
-50
0
50
100
150
200
250


Cross-Section Comparison
9902
El (ft NAVD)
Sta (ft)
1982 Record Drawings
2007 Survey
30
25
20
15
10
5
0
-50
0
50
100
150
200
250
300


Cross-Section Comparison
8467
El (ft NAVD)
25
20
15
10
5
0
-50
0
50
100
150
200
250
300
Sta (ft)
1982 Record Drawings
2007 Survey

Stevens Creek - Crittenden Ln to Hwy 101

WONUM	DESCRIPTION	JOB TYPE	From Station	To Station	LOCAIDE
200516460	STEVENS CK (BLNK) D/S MOFFETT-SIGNAGE AT U/S HWY 101	CORRECTIVE MAINT			2,7
200610870	STEVENS CK (BLNK) D/S 101 RT BANK-REMOVE OLD SIGN & POST	CORRECTIVE MAINT			2,7
200713615	STEVENS CK (BLNK) - @ CRITTENDEN - REM SIGN/REPAIR FENCE	CORRECTIVE MAINT	8847	21226	13,21,31
200820930	STEVENS CRK INSPECTIONS @ VARIOUS LOCATIONS	CORRECTIVE MAINT	8847	21226	13,21,31
200207166	STEVENS CK (BLNK) @ FISH LADDER-REMOVE FALLEN LIMB	DEBRIS-CAPACITY			7(18-78)
200304729	STEVENS CK(BLNK) VAROUS LOCATIONS - REMOVE LOCATION	DEBRIS-CAPACITY			2(18-81)
200308217	STEVENS CK (BLNK) U/S CRITTENDEN - REMOVE WATER TANK	DEBRIS-CAPACITY			2(28-81)
200510730	STEVENS CK(BLNK) D/S L'AVENIDA-REMOVE FALLEN TREE	DEBRIS-CAPACITY			2,7
200612568	STEVENS CK (BLNK) 2 LOCATIONS-REMOVE LIMBS	DEBRIS-CAPACITY			2,7
200619288	STEVENS CK (BLNK) VARIOUS LOC - CUT UP FALLEN TREES	DEBRIS-CAPACITY			2,7
200705852	STEVENS CK (BLNK) U/S L'AVENIDA-REMOVE DEBRIS	DEBRIS-CAPACITY	8847	21226	2,7
200713617	STEVENS CK (BLNK) CRITTENDEN -REMOVE BARB WIRE/CONCRETE	DEBRIS-CAPACITY	8847	21226	13,21,31
200725856	STEVENS CRK @ LA AVENIDA REMOVE T & D	DEBRIS-CAPACITY	8847	21226	20: 18-79
200820138	STEVENS CRK D/S LA AVENIDA REMOVE FALLEN COTTON WOOD	DEBRIS-CAPACITY	8847	21226	13,21,31
200212708	STEVENS CK DROP STRUCTURE - ADMIN SUPPORT- LNDSCP	ENG/TECH SUPPORT			7/18:76
200301747	STEVENS CK DROP STRUCTURE - ADMIN SUPPORT- LNDSCP	ENG/TECH SUPPORT			7/18:76
200807936	STEVENS CK D/S LA AVENIDA - HYDROSEED	EROSION PLANTING	8847	21226	21/18-79
200008836	STEVENS CREEK - FISH LADDER CLEANING BLANKET	FACILITY CLEAN			7(18-78)
200400518	STEVENS CK G/N (EVELYN AVE) T&D REMOVAL-P/M	GOOD NEIGHBOR			7(18-76)
200400521	0STEVENS CK G/N (HIGHWAY 101) T&D REMOVAL-P/M	GOOD NEIGHBOR			7(18-78)
200400522	0STEVENS CK G/N (CRITTENDEN) T&D REMOVAL-P/M	GOOD NEIGHBOR			2(18-81)
200406672	0STEVENS CK G/N (HIGHWAY 101) T&D REMOVAL-P/M	GOOD NEIGHBOR			7(18-78)
200406673	0STEVENS CK G/N (CRITTENDEN) T&D REMOVAL-P/M	GOOD NEIGHBOR			2(18-81)
200412063	0STEVENS CK G/N (HIGHWAY 101) T&D REMOVAL-P/M	GOOD NEIGHBOR			2,7
200412064	STEVENS CK G/N (CRITTENDEN) T&D REMOVAL-P/M	GOOD NEIGHBOR			2(18-81)
200500756	STEVENS CK G/N (HIGHWAY 101) T&D REMOVAL-P/M	GOOD NEIGHBOR			7(18-78)
200500757	STEVENS CK G/N (CRITTENDEN) T&D REMOVAL-P/M	GOOD NEIGHBOR			2(18-81)
200509885	STEVENS CK G/N (HIGHWAY 101) T&D REMOVAL-P/M	GOOD NEIGHBOR			2,7
200509886	STEVENS CK G/N (CRITTENDEN) T&D REMOVAL-P/M	GOOD NEIGHBOR			2,7
200513693	STEVENS CK G/N (EVELYN AVE) T&D REMOVAL-P/M	GOOD NEIGHBOR			7(18-76)
200513696	STEVENS CK G/N (HIGHWAY 101) T&D REMOVAL-P/M	GOOD NEIGHBOR			7(18-78)
200513697	STEVENS CK G/N (CRITTENDEN) T&D REMOVAL-P/M	GOOD NEIGHBOR			2(18-81)
200519440	STEVENS CK G/N (HIGHWAY 101) T&D REMOVAL-P/M	GOOD NEIGHBOR			7(18-78)
200519441	0STEVENS CK G/N (CRITTENDEN) T&D REMOVAL-P/M	GOOD NEIGHBOR			2(18-81)
200519777	STEVENS CK(AVENIDA) - GRAFFITI REM - P/M	GOOD NEIGHBOR			12(19-68)
200601492	STEVENS CK (BLNK) D/S 101 - REMOVE GRAFFITI	GOOD NEIGHBOR			2,7
200601807	STEVENS CK G/N (HIGHWAY 101) T&D REMOVAL-P/M	GOOD NEIGHBOR			7(18-78)
200601808	STEVENS CK G/N (CRITTENDEN) T&D REMOVAL-P/M	GOOD NEIGHBOR			2(18-81)
200602141	STEVENS CK(AVENIDA) - GRAFFITI REM - P/M	GOOD NEIGHBOR			12(19-68)
200608932	STEVENS CK(AVENIDA) - GRAFFITI REM - P/M	GOOD NEIGHBOR			12(19-68)
200614138	STEVENS CK G/N (HIGHWAY 101) T&D REMOVAL-P/M	GOOD NEIGHBOR			7(18-78)
200614139	STEVENS CK G/N (CRITTENDEN) T&D REMOVAL-P/M	GOOD NEIGHBOR			2(18-81)
200614478	STEVENS CK G/N (AVENIDA) - GRAFFITI REM - P/M	GOOD NEIGHBOR			12(19-68)
200619479	STEVENS CK G/N (HIGHWAY 101) T&D REMOVAL-P/M	GOOD NEIGHBOR			7(18-78)
200619480	STEVENS CK G/N (CRITTENDEN) T&D REMOVAL-P/M	GOOD NEIGHBOR			2(18-81)
200619815	STEVENS CK G/N (AVENIDA) - GRAFFITI REM - P/M	GOOD NEIGHBOR			12(19-68)
200700399	STEVENS CK G/N (HIGHWAY 101) T&D REMOVAL-P/M	GOOD NEIGHBOR	8847	21226	7(18-78)
200700400	STEVENS CK G/N (CRITTENDEN) T&D REMOVAL-P/M	GOOD NEIGHBOR	8847	21226	2(18-81)
200700735	STEVENS CK G/N (AVENIDA) - GRAFFITI REM - P/M	GOOD NEIGHBOR	8847	21226	12(19-68)
200712601	STEVENS CK G/N (HIGHWAY 101) T&D REMOVAL-P/M	GOOD NEIGHBOR	8847	21226	21(18-78)
200712602	STEVENS CK G/N (CRITTENDEN) T&D REMOVAL-P/M	GOOD NEIGHBOR	8847	21226	13(18-81)
200712937	STEVENS CK G/N (AVENIDA) - GRAFFITI REM - P/M	GOOD NEIGHBOR	8847	21226	52(19-68)
200722197	STEVENS CK G/N (HIGHWAY 101) T&D REMOVAL-P/M	GOOD NEIGHBOR	8847	21226	21(18-78)
200722198	STEVENS CK G/N (CRITTENDEN) T&D REMOVAL-P/M	GOOD NEIGHBOR	8847	21226	13(18-81)
200722533	STEVENS CK G/N (AVENIDA) - GRAFFITI REM - P/M	GOOD NEIGHBOR	8847	21226	52(19-68)
200731977	STEVENS CK G/N (HIGHWAY 101) T&D REMOVAL-P/M	GOOD NEIGHBOR	8847	21226	21(18-78)
200731978	STEVENS CK G/N (CRITTENDEN) T&D REMOVAL-P/M	GOOD NEIGHBOR	8847	21226	13(18-81)
200732313	STEVENS CK G/N (AVENIDA) - GRAFFITI REM - P/M	GOOD NEIGHBOR	8847	21226	52(19-68)
200801160	STEVENS CK G/N (HIGHWAY 101) T&D REMOVAL-P/M	GOOD NEIGHBOR	8847	21226	21(18-78)
200801161	STEVENS CK G/N (CRITTENDEN) T&D REMOVAL-P/M	GOOD NEIGHBOR	8847	21226	13(18-81)
200801496	STEVENS CK G/N (AVENIDA) - GRAFFITI REM - P/M	GOOD NEIGHBOR	8847	21226	52(19-68)
200813204	STEVENS CK G/N (HIGHWAY 101) T&D REMOVAL-P/M	GOOD NEIGHBOR	8847	21226	21(18-78)
200813205	STEVENS CK G/N (CRITTENDEN) T&D REMOVAL-P/M	GOOD NEIGHBOR	8847	21226	13(18-81)
200813541	STEVENS CK G/N (AVENIDA) - GRAFFITI REM - P/M	GOOD NEIGHBOR	8847	21226	52(19-68)
200827329	STEVENS CK G/N (HIGHWAY 101) T&D REMOVAL-P/M	GOOD NEIGHBOR	8847	21226	21(18-78)
200827330	STEVENS CK G/N (CRITTENDEN) T&D REMOVAL-P/M	GOOD NEIGHBOR	8847	21226	13(18-81)
200827665	STEVENS CK G/N (AVENIDA) - GRAFFITI REM - P/M	GOOD NEIGHBOR	8847	21226	52(19-68)
200837061	STEVENS CK G/N (HIGHWAY 101) T&D REMOVAL-P/M	GOOD NEIGHBOR	8847	21226	21(18-78)
200837062	STEVENS CK G/N (CRITTENDEN) T&D REMOVAL-P/M	GOOD NEIGHBOR	8847	21226	13(18-81)
200837398	STEVENS CK G/N (AVENIDA) - GRAFFITI REM - P/M	GOOD NEIGHBOR	8847	21226	52(19-68)
200204606	STEVENS CK (BLNK) AAC SIGN INSTALLATION (CUB SCOUT PACK #415)	GOOD NEIGHBOR AC			7(18-76)
200514850	STEVENS CK (BLNK)-HWY 101 & MOFFETT BLVD-G/N AAC SIGN	GOOD NEIGHBOR AC			
200612451	STEVENS CK - U/S HWY 101-LEVEE ROAD WORK	LEVEE MAINT			2,7
200804698	STEVENS CRK @ L'AVENIDA LEVEE REPAIR	LEVEE MAINT	12880	13000	
200823610	STEVENS CREEK U/S CRITTENDEN GROUT VOIDS	LEVEE MAINT	8847	21226	
200011113	STEVENS CK - LEVEE D/S 101 - EXPOSE WELL	PROPERTY MAINT			2(18-80)
200015325	STEVENS CK-CRITTENDEN TO 101-PLACE ROCK	PROPERTY MAINT			2,7
200102029	STEVENS CK - D/S L'AVENIDA - SEDIMENT REMOVAL	SEDIMENT REMOVAL			7(18-79)
200200874	STEVENS CK - D/S L'AVENIDA - SEDIMENT REMOVAL	SEDIMENT REMOVAL			7(18-79)
200504738	STEVENS CK @ L'AVENIDA - SEDIMENT REMOVAL	SEDIMENT REMOVAL			2,7
200014693	STEVENS C-(BLNK) U/S CRITTENDEN-TRASH PICK UP	TRASH/DEBRIS REM			2,7
200109678	STEVENS CK - D/S 101 - REMOVE FALLEN TREE (MOU-H L)	VEG-NON-CHEM			2(18-81)
200408921	STEVENS CK (BLNK)- VARIOUS LOC - CUT & FLOAT FALLEN TREES	VEG-NON-CHEM			7(18-77)

Stevens Creek Velocities at Toe of Levee		
Station	West Levee Velocity (ft/s)	East Levee Velocity (ft/s)
8439	3.27	5.59
8467	3.57	5.32
8533	4.15	3.91
8577	4.41	4.38
8613	3.75	2.54
8657	2.97	2.91
8697	3.03	4.36
8901	3.4	3.92
9098	3.27	2.99
9300	3.24	2.93
9501	3.23	2.94
9698	3.21	2.98
9902	3.18	3.06
10097	3.39	3.09
10203	3.36	3.04
10296	3.28	2.99
10397	3.09	2.88
10502	2.94	2.79
10596	2.77	2.6
10699	3.11	2.89
10799	3.11	2.89
10899	2.93	2.87
10998	2.9	2.74
11103	3.18	3.72
11170	4.07	3.67
11196	3.54	3.53
11299	3.43	3.37
11398	4.04	4.13
11496	3.98	4.05
11596	3.93	4.09
11695	3.86	4.11
11799	3.96	4.1
11897	3.88	4.07
11997	3.88	4.03
12098	3.91	4.02
12199	3.94	3.97

TAB 8

RESIDUAL INTERIOR DRAINAGE ANALYSIS

for

STEVENS CREEK LEVEE RECERTIFICATION

MOUNTAIN VIEW, CALIFORNIA

Prepared

January 2009

For:

Santa Clara Valley Water District
City of Mountain View

Under the Direct Supervision of:

REGISTERED PROFESSIONAL ENGINEER
CHARLES D. ANDERSON
No. 43776
EXP. 6/30/09
CIVIL
STATE OF CALIFORNIA

CHARLES D. ANDERSON, RCE No. 43776, Exp 6/30/09

Schaaf & Wheeler
CONSULTING CIVIL ENGINEERS

100 N. Winchester Blvd., Suite 200
Santa Clara, CA 95050
(408) 246-4848
FAX (408) 246-5624

Interior Drainage Analysis for Stevens Creek Levee Recertification
City of Mountain View, California (Community No. 060347)
County of Santa Clara, California (Community No. 060337)

INTRODUCTION

This interior drainage analysis for the subject levee recertification has been completed in accordance with Paragraph 65.10(b)(6) of the National Flood Insurance Program (NFIP) regulations:

> "An analysis must be submitted that identifies the source(s) of [interior] flooding, the extent of the flooded area, and, if the average depth is greater than one foot, the water-surface elevation(s) of the base flood. This analysis must be based on the joint probability of interior and exterior flooding and the capacity of facilities (such as drainage lines and pumps) for evacuating interior flood waters."

Limits of Detailed Study. This analysis encompasses areas interior to the east bank and west bank levees of Stevens Creek within the City of Mountain View, California and unincorporated Santa Clara County, California between U.S. Highway 101 and Crittenden Lane, or the reach of Stevens Creek subject to Provisional Accreditation as indicated on Figure 1.

Figure 1. Location of Interior Drainage Analysis

Summary of Residual Interior Flooding. The interior drainage analysis contained herein demonstrates a lack of residual one-percent interior flooding for the subject reach of levee recertification. Consequently flood mapping for the interior area will not change from the current digital Flood Insurance Rate Map (DFIRM) for the area, which shows interior flooding from tidal inundation (Zone AE at 11 feet NAVD) and Shaded Zone X (areas protected by levees from 100-year flood). A Letter of Map Revision Based on Fill (LOMR-F) has been submitted under separate cover to slightly revise the flood zone boundaries and reflect the most current topographic information. Appendix E contains maps showing those interior areas subject to tidal inundation.

BACKGROUND

The Santa Clara Valley Water District (District) has co-signed a PAL agreement to re-certify certain levees on Stevens Creek within the City of Mountain View (City). The District and City are participating in FEMA's Map Modernization Program (MapMod) to reflect the current reality of the natural and man-made environments as they relate to flood hazards. District and City participation in MapMod includes the accreditation of District levees that provide protection from the base flood, that is, the one percent annual chance flood also referred to as the "100-year flood." Certain levees believed to meet federal standards for levee performance – as listed in the Code of Federal Regulations, Title 44, Section 65 (44 CFR §65) – are thought to be eligible as Provisionally Accredited Levees (PAL) and are currently shown as providing one-percent flood protection on Flood Insurance Rate Maps (FIRMs).

To receive FEMA accreditation, the levee must be shown to conform to the requirements of 44 CFR §65.10 as indicated by the terms of the Provisionally Accredited Levee Program (PAL):

> "To the best of [the District's and City's the [subject] levee…meets the requirements of 44 CFR 65.10 and has been maintained in accordance with an adopted operation and maintenance plan and records of levee maintenance and operation, as well as tests of the mechanized interior drainage system if applicable….."

DRAINAGE FACILITIES

Three major outfalls drain Mountain View's tributary areas to Stevens Creek downstream of U.S. Highway 101. According to record information provided by the City, local storm water runoff upstream of Highway 101 is captured and delivered to Stevens Creek by the storm drain system. Storm water runoff does not cross Highway 101. There are also a few small gravity outfalls to Stevens Creek through both levees as summarized in Table 1. Outfall locations have been determined from record drawings for the levees provided by the District and field reconnaissance. Where storm water drainage is pumped, pump station capacities are based upon the City of Mountain View "Citywide Storm Drainage Master Plan." (Nolte, 2005)

Table 1. Interior Drainage Outfalls

Facility	Bank/ Creek Station	Tributary Area (mi^2)	Total Pumping Capacity (cfs)	Storage (ac-ft)	Standby Power
U/S Limit of Levee Recertification	143+25	---	---	---	---
21" gravity outfall	E137+00	<0.01	---	---	n/a
15" gravity outfall	E128+25	<0.01	---	---	n/a
78" gravity outfall at La Avenida	W127+10	0.09	---	---	n/a
21" gravity outfall	E124+83	<0.01	---	---	n/a
24" gravity outfall	E117+18	<0.01	---	---	n/a
Private Pump Station	W117+10	---	???	---	no
Private Pump Station	W111+70	---	???	---	no
Abandoned 48" gravity outfall	W98+36	---	---	---	n/a
Charleston Pump Station outfall	W94+00	0.53	77	22.3	yes
D/S Limit of Levee Recertification	84+20	---	---	---	---
Crittenden Pump Station outfall	W69+85	0.23	150	0.0	yes

Mr. Ken Kono of NASA/Ames states that federally controlled land on the east side of the creek, other than the small areas indicated in Table 1, drains to a basin near San Francisco Bay, where storm water runoff eventually evaporates or is pumped. Since the ground naturally drains away from the creek toward this basin even if the small outfalls to the creek are closed by high stage, and the tributary areas are very small, further analysis of the eastern interior areas is not warranted.

On the west side of the creek, an interior area generally bound by U.S. Highway 101 to the south (which acts as an interior barrier), Stevens Creek to the east, Macon Avenue to the west and Villa Drive to the north drains to the creek by gravity through a 48-inch storm drain with a 78-inch CMP outfall at La Avenida Street. Interior areas west to Permanente Creek and north to Crittenden Lane drain to the Charleston Detention Pond and Pump Station, which provides storage and automatic pump capacity. The Charleston facility is also assumed to drain areas served by private pump stations lacking standby power. Although located outside the area of levee recertification, the Crittenden Pump Station is included in the analysis since there could be spill from its tributary area into the interior area analyzed for levee recertification. Figure E.1 (Appendix E) shows the interior basin delineation.

METHODOLOGY

The key aspect of §65.10(d) is that the interior drainage study must be based on "the joint probability of interior and exterior flooding." FEMA archives have been scoured to find the original storm patterns used to compute the discharge hydrograph for Stevens Creek, and that same storm pattern is used in the interior drainage study so that interior and exterior (i.e. creek) runoff are based on the same one-percent storm. The basic methodology used herein involves:

1. Obtaining the 24-hour storm patterns used to produce the Stevens Creek hydrograph published in the effective Flood Insurance Study.
2. Balancing those patterns to preserve local rainfall statistics.
3. Using a statistically balanced 24-hour storm pattern, calibrate soil loss parameters (specifically using Antecedent Moisture Condition) to replicate the flood-frequency analysis of recorded streamflow at a nearby USGS gage.
4. Using the locally balanced storm pattern and calibrated AMC, calculate interior storm water runoff hydrographs at each outfall location using District procedures.
5. Route runoff hydrographs through drainage facilities at each outfall, ascertain whether there is residual ponding, and if so, map any ponding greater than one foot in depth.

Design Storm Patterns. 100-year, 24-hour precipitation patterns and Stevens Creek hydrographs are obtained from microfiche and original records of the currently effective Santa Clara County Flood Insurance Study (FIS). Copies of these records may be found in Appendix A of this document. Precipitation patterns used in the original FIS are based on storms recorded by the U.S. Army Corps of Engineers in the late 1950s and provided to the FIS Study Contractor by the Water District in 1976. The patterns vary slightly with the total storm precipitation.

Statistical Balance. Statistically balancing the FIS storm pattern ensures the consistency of interior runoff calculations with local depth-duration-frequency rainfall statistics provided by the Santa Clara Valley Water District. Since unit hydrograph computations rely upon the Rational Method for calculating times of concentration, the balanced Intensity-Duration-Frequency (IDF) curve used to compute time of concentration is also consistent with the FIS storm hyetograph.

The FIS precipitation pattern is balanced using the hydrograph transform function of HEC-1 to compile a precipitation distribution that better correlates with depths calculated from the Santa Clara Valley Water District's Return Period-Duration-Specific (TDS) Regional Equation, as described in Section 3.5 of the 2007 Santa Clara Valley Drainage Manual for a 100-year return period using duration time intervals of 15 minutes, one hour, two hours, three hours, six hours, and 24 hours. The interior drainage area in Mountain View experiences a mean annual precipitation of 14 inches. The TDS equation is:

$$x_{T,D} = A_{T,D} + B_{T,D}\ MAP$$

where $x_{T,D}$ is the precipitation depth for a specific return period and storm duration (inches)

T is the return period (years)

D is the storm duration (hours)

A, B are dimensionless coefficients from Tables B-1 and B-2 of Santa Clara County Drainage Manual (see Appendix B)

MAP is the Mean Annual Precipition (inches) from Figure A-2 of Santa Clara County Drainage Manual (see Appendix B)

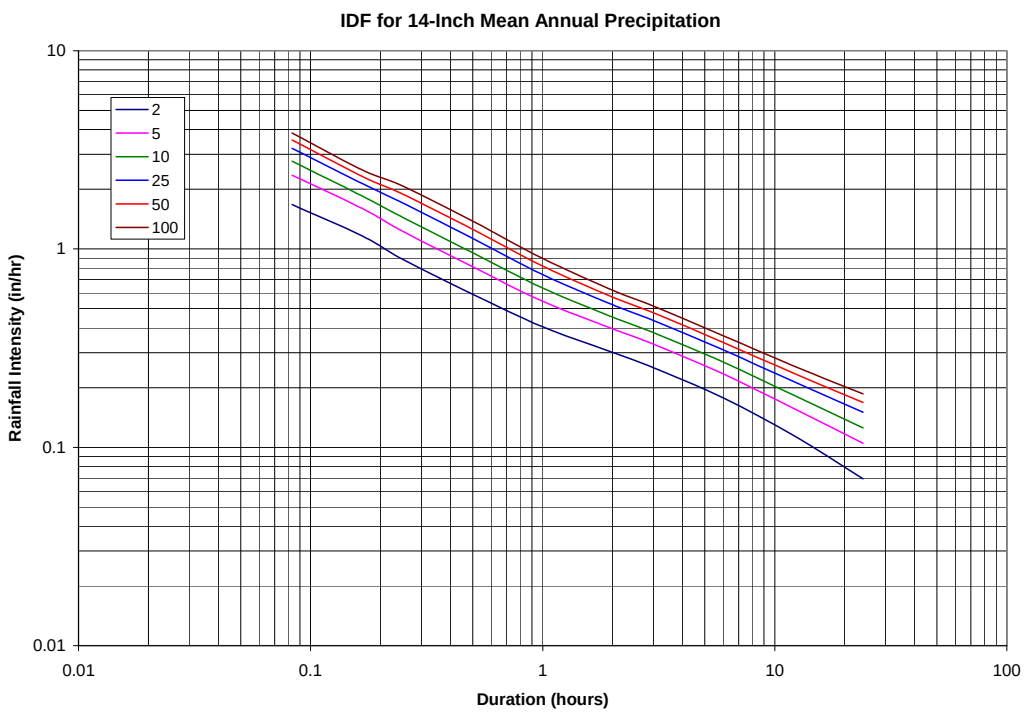


Table 2 provides rainfall depths for a 100-year storm of various durations with a 14 inch mean annual precipitation. Full calculations for the pattern transformation and statistical balance are contained in Appendix C. Figure 2 shows the balanced 24-hour pattern compared to the original 24-hour pattern from the FIS.

Table 2. Rainfall Depths for 24-hour Balanced Storm

MAP = 14 inches				
Duration (minutes)	**Duration (hours)**	**A**	**B**	**Depth (in)**
15	0.25	0.4214	0.0070	0.52
60	1.00	0.6266	0.0192	0.90
120	2.00	0.7329	0.0362	1.24
360	6.00	0.7767	0.1011	2.19
1440	24.00	0.8140	0.2434	4.22

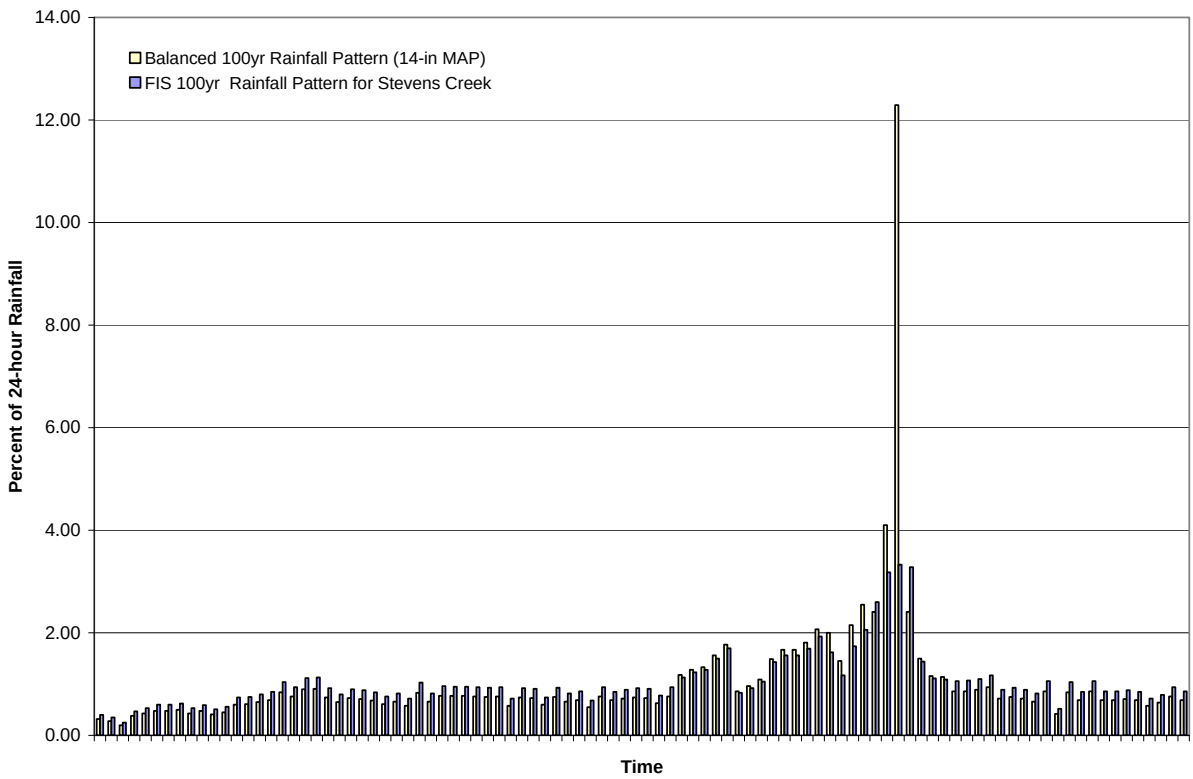


Figure 2. Statistically Balanced Rainfall Pattern for Interior Drainage Analysis

Watershed Model Calibration. To improve estimates of one-percent discharge for interior drainage analyses, the following procedure is used to calibrate watershed models using a flood frequency analysis of recorded streamflow gage data for nearby San Francisquito Creek. This same procedure was used as the hydrologic basis for a Letter of Map Revision obtained from FEMA on October 26, 2006 for the District's Matadero and Barron Creeks Long-Term Remediation Project.

1. Perform a statistical analysis of streamflow data at the nearby USGS gage on San Francisquito Creek at Stanford. The one-percent discharge is 7,800 cfs.

2. Prepare a rainfall-runoff model for the watershed tributary to the San Francisquito Creek gage, which is hydrologically similar to Mountain View.

3. Use the balanced 100-year rainfall pattern described above to calibrate the San Francisquito Creek model for Antecedent Moisture Condition. The calibration watershed's mean annual precipitation is 31 inches.

4. Construct detailed rainfall-runoff models for each Stevens Creek watershed using a unit hydrograph procedure, applying the balanced local rainfall pattern and calibrated antecedent moisture condition.

Balancing the 24-hour FIS rainfall pattern for a mean annual precipitation of 31 inches is similar to the procedure described for a mean annual precipitation of 14 inches. Table 3 summarizes rainfall depth distributions, and Figure 3 shows the statistically balanced pattern.

Table 3. Rainfall Depths 24-hour Balanced Storm

MAP = 31 inches				
Duration (minutes)	**Duration (hours)**	**A**	**B**	**Depth (in)**
15	0.25	0.4214	0.0070	0.64
60	1.00	0.6266	0.0192	1.22
120	2.00	0.7329	0.0362	1.85
360	6.00	0.7767	0.1011	3.91
1440	24.00	0.8140	0.2434	8.36

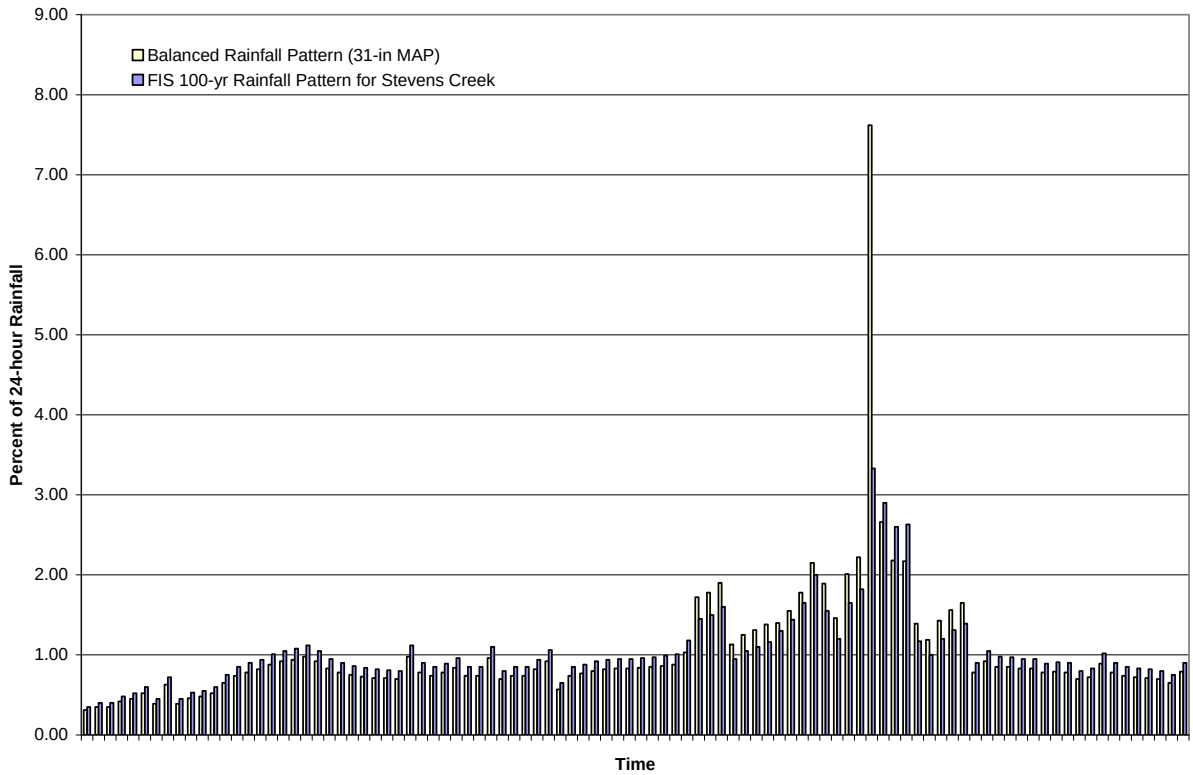


Figure 3. Statistically Balanced Rainfall Pattern for Model Calibration

The unit hydrograph method is used to calculate interior storm water runoff hydrographs and to calibrate the antecedent moisture condition (AMC) for the neighboring San Francisquito Creek watershed. A unit hydrograph is a numerical representation of the time response of catchment runoff caused by one inch of excess rainfall applied uniformly over a unit of time. Many different techniques are available to estimate unit hydrographs for rainfall-runoff convolution. The San Francisco District Corps of Engineers "S-Graph" was used to calibrate AMC for the Matadero Creek

LOMR. The previously approved calibration model is therefore not revised for this analysis. The S-Graph method requires an estimate of basin lag, which is the time from the beginning of excess rainfall (i.e. direct runoff) to the point in time when fifty percent of the runoff has passed the catch point. The USACE equation for basin lag is:

$$t_{lag} = 24\,n\left(\frac{L\,L_c}{\sqrt{S}}\right)^{0.38}$$

where

t_{lag}	is defined above (hours)
n	is a function of basin urbanization (dimensionless)
L	is the length of flow from the highest point in a catchment to its outlet (mi)
L_c	is the length from a point perpendicular with the basin centroid to its outlet (mi)
S	is the average basin slope in (ft/mi)

Direct runoff is estimated by subtracting soil infiltration and other losses from the rate of rainfall. The Curve Number (CN) method is an empirical methodology derived by the Soil Conservation Service (SCS). The Curve Number is an abstraction that reflects the potential loss for a given soil and cover complex. In this methodology, an initial abstraction must be satisfied before there will be any direct overland runoff. This abstraction represents rainfall that is absorbed by tree cover, depressions, and soil. After satisfying the initial abstraction, the soil becomes saturated at a certain rate so that a higher percentage of the accumulated rainfall becomes converted into runoff.

Estimates of the CN are made based on the soil types and cover within a drainage basin. The number varies from 0 to 100, and represents the relative runoff potential for a given soil-cover complex for given antecedent moisture conditions (that is, how wet it was prior to any precipitation event).

Curve numbers for the calibration of antecedent moisture and application to the Stevens Creek watershed models are based on published CN tables and Hydrologic Soil Groups established on maps prepared by the SCS. Soil cover and land uses are based on aerial photographs, USGS Quadrangle maps, and field reconnaissance. As stated previously, the antecedent moisture condition (AMC) is calibrated to the results of flood frequency analyses for San Francisquito Creek. AMC is characterized by the SCS as:

AMC I	soils are dry
AMC II	average conditions
AMC III	heavy rainfall, or light rainfall with low temperatures; saturated soil

Antecedent moisture conditions are established for the storm pattern used in the interior drainage analysis. Schaaf & Wheeler developed curve numbers and other basin parameters for the San Francisquito Creek basin, and these parameters were subsequently approved by FEMA. (Schaaf & Wheeler, 2001) Appendix D contains a frequency plot for San Francisquito Creek at Stanford following procedures outlined in USGS Bulletin #17B (USGS, 1982). Summarizing the calibration provided in Appendix D (Table 4):

San Francisquito Creek at USGS Gaging Station

Area = 37 mi^2	"n" = 0.08 (USACE)
SCS Curve No. 68 (AMC II)	L = 63,800 feet = 12.08 mi
Percent Impervious = 5	L_C = 28,000 feet = 5.30 mi
Mean Annual Precipitation = 31 inches	S = 0.016 = 84 ft/mi
100-year, 24-hour Depth = 8.36 inches t_{lag} = 4 hours	$Q_{1\%}$ = 7,800 cfs

Table 4. Calibration of AMC for Watershed Modeling

Return Period	Peak Discharge (cfs)	Calibrated CN	Calibrated AMC	AMC Used
100-year (1%)	7,811	60	1.6	II

Modeling Stevens Creek Interior Watersheds. Using statistical rainfall data from the Santa Clara Valley Water District, the design storm pattern and a calibrated AMC value, interior runoff hydrographs for individual catchments are derived and combined to produce discharge estimates at the points of interest. Where necessary, flood hydrographs are routed through storage facilities. Hydrologic modeling results are presented in Appendix C of this report.

To evaluate collection system facilities with coincident discharge in Stevens Creek, a synthetic unit hydrograph procedure is used with aforementioned rainfall pattern to produce requisite runoff hydrographs through a process known as convolution. A unit hydrograph is defined as the basin runoff produced by one inch of rainfall excess applied uniformly over the basin over that "unit" of time. District procedures call for the use of Clark's two-parameter dimensionless unit hydrograph. The first parameter, t_c, is equal to the time of concentration (in hours) for a catchment. The second prameter, R, is a storage coefficient (in hours) which modifies the "peakedness" of the unit hydrograph. R is related to t_c by the following ratio:

$$\frac{R}{t_c + R}$$

which generally ranges between 0.1 and 0.5 within urbanized areas and is set in this analysis based on the amount of open space within each interior basin. Times of concentration for individual storm drain systems are calculated using the Rational Formula and the balanced IDF curve presented earlier. The Rational Formula uses a runoff coefficient to convert rainfall intensity over a time of concentration into direct runoff:

$$Q = k\,C\,i\,A$$

where k is a unit conversion factor (1.008), C is the runoff coefficient, *i* is the rainfall intensity (inches per hour) for a given duration equivalent to the time of concentration at any design point, and A is the total tributary basin area at that design point. Runoff coefficients have been established for three basic ground surfaces found within the interior: roofs, paved areas, and lawn (pervious areas). The runoff coefficients for the three ground covers are based on Type D soil values from Table 3-1 of the 2007 *Santa Clara County Drainage Manual*. All pervious lawn areas are assigned a runoff coefficient of 0.45, equal to that of the Urban Open Space coefficient provided in Table 3-1. Paved areas are given a coefficient of 0.85, equal to that of the Paved/Impervious Surface section of Table 3-1. Roofs are assumed to contribute more direct runoff from the same direct precipitation relative to pavement, and are therefore assigned a higher runoff coefficient. Table 5 summarizes the runoff coefficients assigned to each ground cover. Composite runoff coefficients for a tributary area are obtained using a weighted areal average.

Table 5. Runoff Coefficients

Description	Runoff Coefficient (C)
Roof	0.90
Paved area	0.85
Lawn/Open	0.45

Rainfall intensity (i) is obtained using the Intensity-Duration-Frequency (IDF) curve presented above, which is consistent with the balanced rainfall pattern ultimately used to generate runoff hydrographs. The 100-year IDF curve can be represented as a power function:

$$i = \frac{K}{t^n}$$

where *i* is the rainfall intensity in inches per hour;
t is the rainfall duration (time of concentration) in hours; and
K, n are power function coefficients; 1.02 and 0.52, respectively.

The time of concentration for each sub-basin assumes an initial roof-to-gutter time (where appropriate) of ten minutes, plus travel time to the most upstream storm drain inlet, plus the travel time within the storm drain system from the upstream catch point, based on an assumption of surcharged (full) pipe flow. Pipe and street capacities between storm drain system nodes are checked to ensure that the depth of street flow is less than one foot within each interior basin.

Travel time to the most upstream inlet is calculated using the using the Kerby-Hathaway formula (Hjelmfelt, 1986):

$$t_{co} = 0.01377\left[(L\,n)^{0.47}\,S^{-0.235}\right]$$

where t_c is the time of concentration in hours, L is the flow travel distance in feet, n is the Manning's watershed roughness coefficient for overland flow (0.015 for pavement; 0.25 for sparsely covered open space; and 0.4 for well vegetated open space), and S is the average slope in ft/ft.

Pipe capacities are calculated using Manning's formula:

$$Pipe\,Capacity = \frac{1.49}{n}\,\frac{\pi D^{8/3}}{(4)^{5/3}}\,S^{1/2}$$

where n is Manning's coefficient (0.013 for RCP; 0.024 for CMP), D is the storm drain diameter, and S is the hydraulic gradient between system nodes assuming full pipe flow. (During the one-percent event, storm drains are almost universally surcharged in this part of Mountain View.)

The difference between estimated discharge and pipe capacity at any node is assumed to be carried in the street right-of-way. Should the depth of street flow exceed 0.5 foot above the top of curb, it would be mapped as an AO zone. Therefore, the spreadsheets track the capacity for flow within the street-right-of-way at 0.5 foot above top of curb. As long as the street has sufficient capacity, flood hazard mapping falls into the Shaded Zone X currently shown on the DFIRM and no mapping change is required due to the interior drainage analysis. Street capacity is calculated using Manning's formula for normal depth:

$$Street\ Capacity = \frac{1.49}{n}\,A\,R^{2/3}\,S^{1/2}$$

where S is defined as street slope (ft/ft) and the product of the remaining terms is called the conveyance, K. Using a Manning's coefficient of 0.016 for AC pavement, street conveyance is calculated for the typical rights-of-way by Table 6. Cross slopes are assumed to be two percent.

Table 6. Street Conveyance

Street Right-of-Way	W (ft)	D/2 (ft)	Area (ft^2)	Wetted Perimeter (ft)	Hydraulic Radius (ft)	Conveyance K
60 feet	10	20	42	62	0.68	3020
80 feet	10	30	52	82	0.63	3570
100 feet	10	40	58	102	0.57	3710

The Rational Formula is used to estimate travel time within the storm drain system and hence the total the time of concentration for a given catchment. That total time of concentration and the Clark Storage Coefficient produce a synthetic unit hydrograph using the SCS Curve Number (CN) Method for losses. The SCS CN is determined using Table C.3 from the Santa Clara Valley Water District Hydrology Manual (See Appendix F of this report). Antecedent moisture is calibrated to AMC II and curve numbers for type D soil are used. Pervious areas assume a CN of 89 for "Open Space in Poor Condition". Although much of the local lawn areas are in fair to good condition, much of the interior open space is fallow dirt or landfill, so the more conservative condition assessment has been adopted. A percentage of impervious cover for buildings, pavement and hardscape is obtained using aerial photography.

ANALYSES OF INTERIOR DRAINAGE FACILITIES

Synthetic unit hydrographs generated for each basin using the techniques previously described are convolved with the balanced 24-hour, 100-year storm pattern to produce runoff hydrographs for each basin. The hydrographs are combined and routed through the three major drainage facilities in Mountain View as described below.

La Avenida Street Outfall. Although catch basins in this drainage are connected to the Charleston Pump Station system through a 24-inch diameter pipe, the system primarily drains directly to Stevens Creek through a 48-inch RCP pipe and a 78-inch CMP through the levee. Pertinent Basin parameters are provided below. Detailed time of concentration calculations and HEC-1 hydrograph computations may be found in Appendix C assuming full pipe flow. Street capacity is not calculated since hydraulic grades depend upon the coincident energy grade in Stevens Creek.

Basin Area = 55.15 acres (0.09 mi^2)

Net C = 0.81; Percent Impervious Surface = 84

Initial t_c = 10 minutes roof to gutter + 600′ pavement at 1% slope = 17 minutes

Basin t_c = 20.8 minutes = 0.35 hour; Set R / t +R = 0.1; R = 0.039

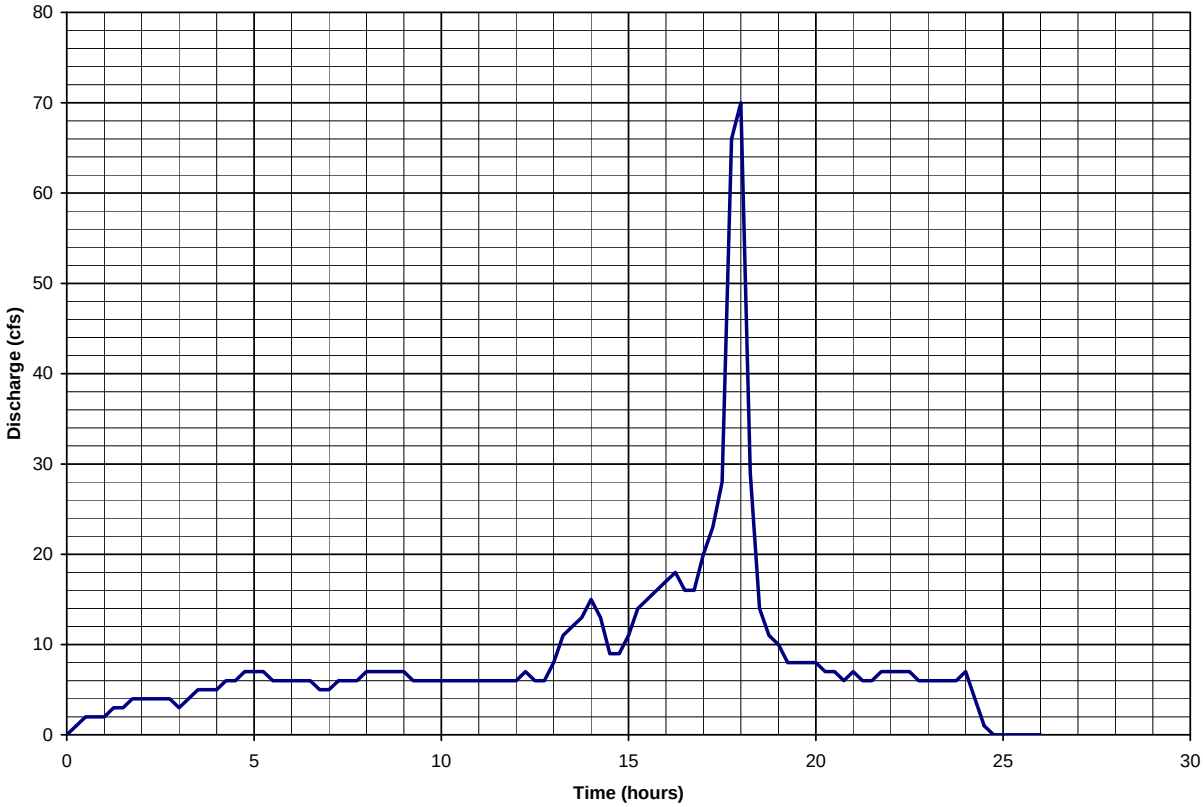


Figure 4. Coincident One Percent Interior Runoff Hydrograph at L'Avenida Street Outfall

Figure 4 shows the computed hydrograph from Appendix C. This runoff hydrograph discharges to Stevens Creek against the coincident energy grade (stage) hydrograph, calculated in the effective FIS with the same precipitation pattern. The HEC-RAS model built for Stevens Creek levee freeboard evaluation is used to produce the stage hydrograph at the outfall location (Section 126+94) by computing the water surface profile in the unsteady analysis mode with the creek hydrograph at Highway 101 as the upstream boundary condition. The coincident one-percent tide in San Francisco Bay is the downstream boundary condition. Figure 5 shows the FIS hydrograph for Stevens Creek at Highway 101 without any channel capacity restrictions; which is the assumption made for levee recertification.

As indicated by Spreadsheet C.1, if the peak interior basin discharge is assumed coincident to the Stevens Creek stage hydrograph, the interior 100-year energy grade is less than one foot above the ground elevation and there is no mapped residual interior flooding.

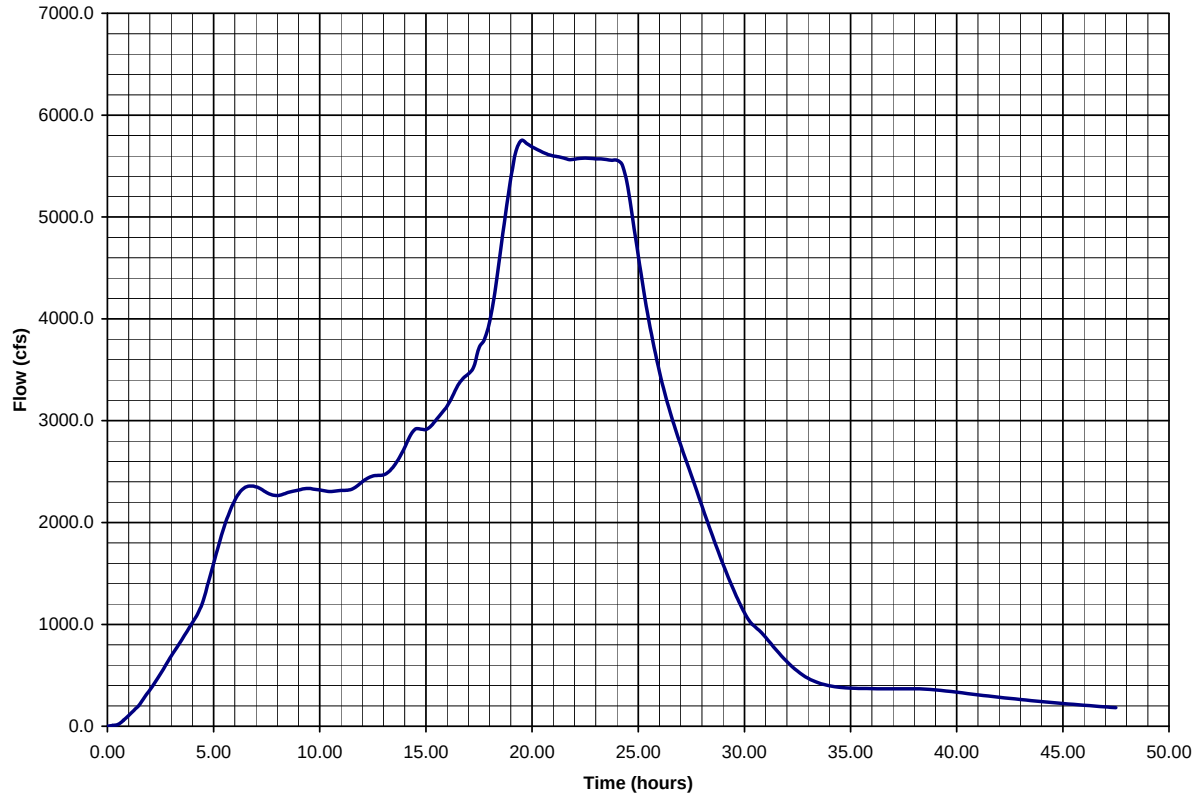


Figure 5. Coincident One Percent Discharge Hydrograph for Stevens Creek at 101

Outfall capacity at La Avenida Street is checked using Manning's equation for friction loss in a pipe under pressure flow:

$$H_f = L\left(\frac{Qn}{1.49AR^{2/3}}\right)^2$$

where H_f is the friction loss in feet;
L is the length of pipe in feet;
Q is the total flow in the pipe in cfs;
n is the Manning's roughness coefficient, in this case 0.013;
A is the cross-sectional flow area of the pipe in ft^2;
R is the hydraulic radius, in feet (A/P); and
P is the wetted perimeter in feet, equal to the pipe circumference since it is assumed to be flowing full.

Additional pipe losses include an exit loss (equivalent to one velocity head, or $V^2/2g$) and an entrance loss to the system, set at one-half velocity head. Appendix C contains pipe loss calculations for the hydrograph shown in Figure 4 discharging against the energy grade in Stevens Creek calculated from the effective HEC-RAS model with the discharge hydrograph of Figure 5 as its upstream boundary condition. These calculations (Spreadsheet C.2) are summarized in Figure 6.

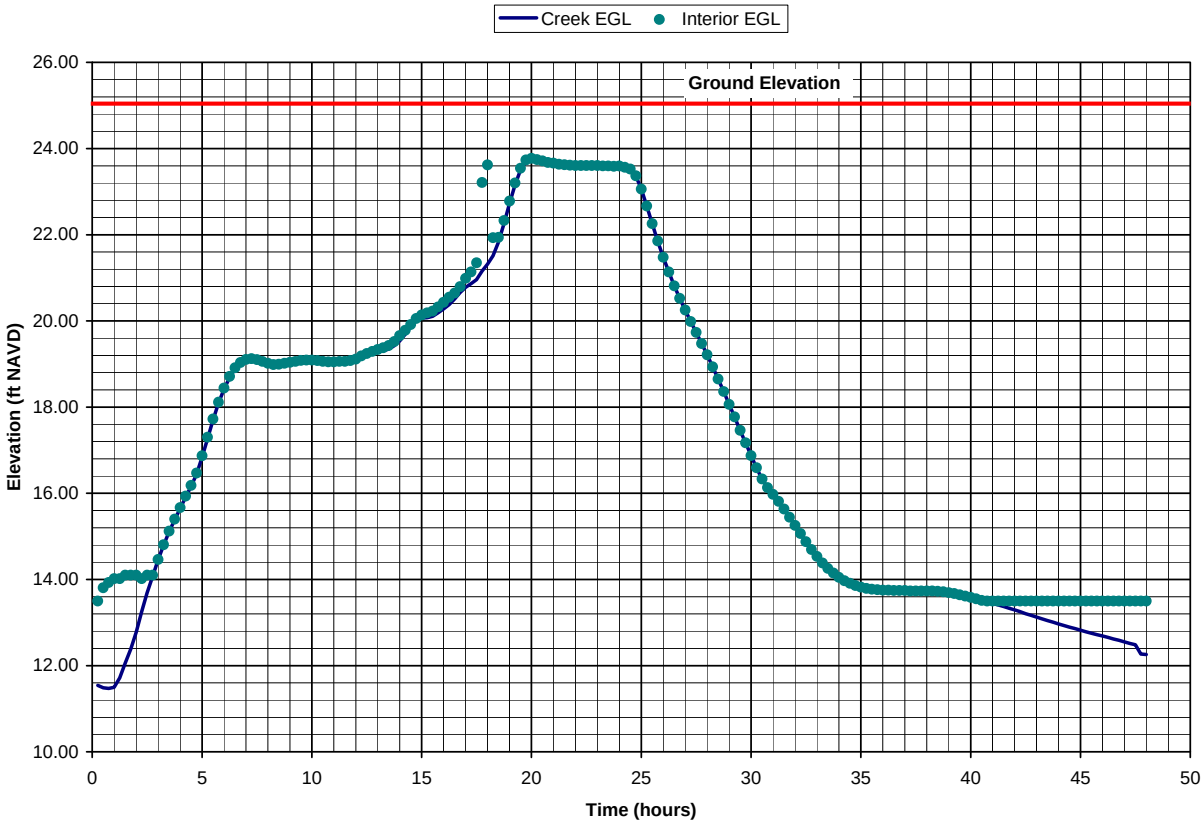


Figure 6. Performance of Gravity Outfall to Stevens Creek at La Avenida Street

Interior energy grade for discharge to the creek does not exceed the ground elevation during the 24-hour, 100-year storm event published in the FIS.

Charleston Pump Station Outfall. On La Avenida Street, the storm drain systems splits with most of the drainage discharged to Stevens Creek through the 78-inch gravity outfall analyzed above, and the remainder of the area discharged through a storm drain system that outfalls at the western terminus of the Charleston Detention Pond. Local runoff also collects in the detention pond and water stored in the pond is pumped to Stevens Creek at Station 94+00 on the west bank. Pertinent basin parameters are provided below. Hydrograph computations are provided in Appendix C. Times of concentration and hydraulic grades are calculated by Spreadsheet C.3.

<u>West Outfall</u>

Basin Area = 147.04 acres (0.23 mi^2)

Net C = 0.74

Initial t_c = 10 minutes roof to gutter + 800′ pavement at 1% slope = 17.8 minutes

Basin t_c = 37.8 minutes = 0.63 hour; Set R / t +R = 0.4; R = 0.420

Percent Impervious Cover = 68

Area Directly Tributary to Detention Pond

Basin Area = 192.64 acres (0.30 mi^2)

Basin t_c = 10 min. roof to gutter + 2,000′ pavement at 0.3% slope + 100′ overland flow at 1% slope + 900′ pavement at 1% slope + 1,300′ of pipe flow at 5 fps = 10 + 16 + 14 + 8 + 4 = 52 min. = .87 hour

Set R / t + R = 0.2; R = 0.218

Percent Impervious Cover = 80

Figure 7 shows the combined hydrograph computed in Appendix C.

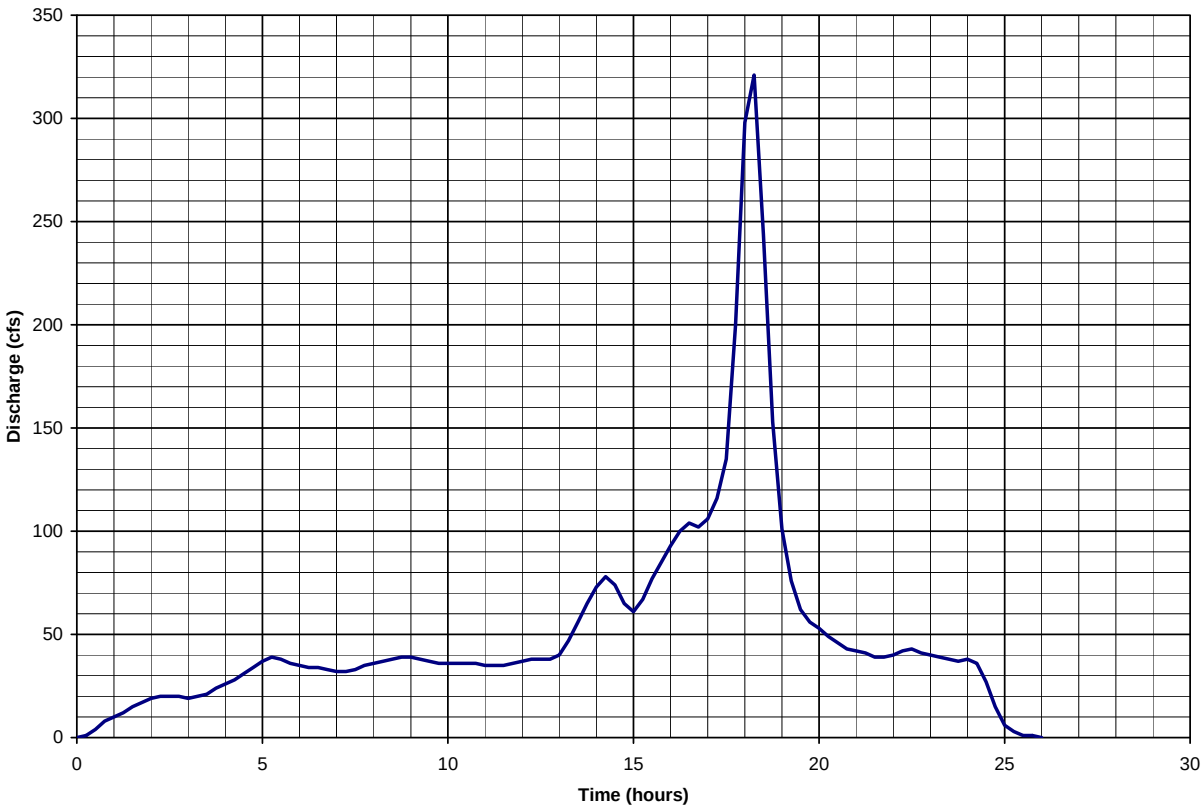


Figure 7. Coincident One Percent Interior Runoff Hydrograph to Charleston Detention Pond

The Charleston Pump Station is located at the east edge of the Charleston Detention Pond. The pond is connected to the pumps through a triangular shaped concrete intake which leads to a concrete wetwell beneath the pump station. The pumps discharge to a sealed concrete chamber, which drains to Stevens Creek through a 30-inch diameter pipe. The pump station is equipped with two 150 hp engine driven pumps with fully automated battery backup and one 50 hp electric pump. Only the combined pumping capacity of the engine-driven pumps is recognized by FEMA for interior mapping, since the smaller electric pump is not operational without PG&E power. (Pump capacity is not significantly impacted by the water surface elevation in Stevens Creek.)

Since inflow to the Charleston Detention Pond exceeds the total pump station capacity of 77 cfs with full backup, storm water is stored in the detention pond. Pump settings and a storage-elevation curve calculated for the pond based on 2006 LiDAR topography (Figure 8) are used to route the inflow hydrograph. Water is stored to an approximate elevation of 9 feet NAVD before being released in a ditch that drains to the Crittenden Pump Station.

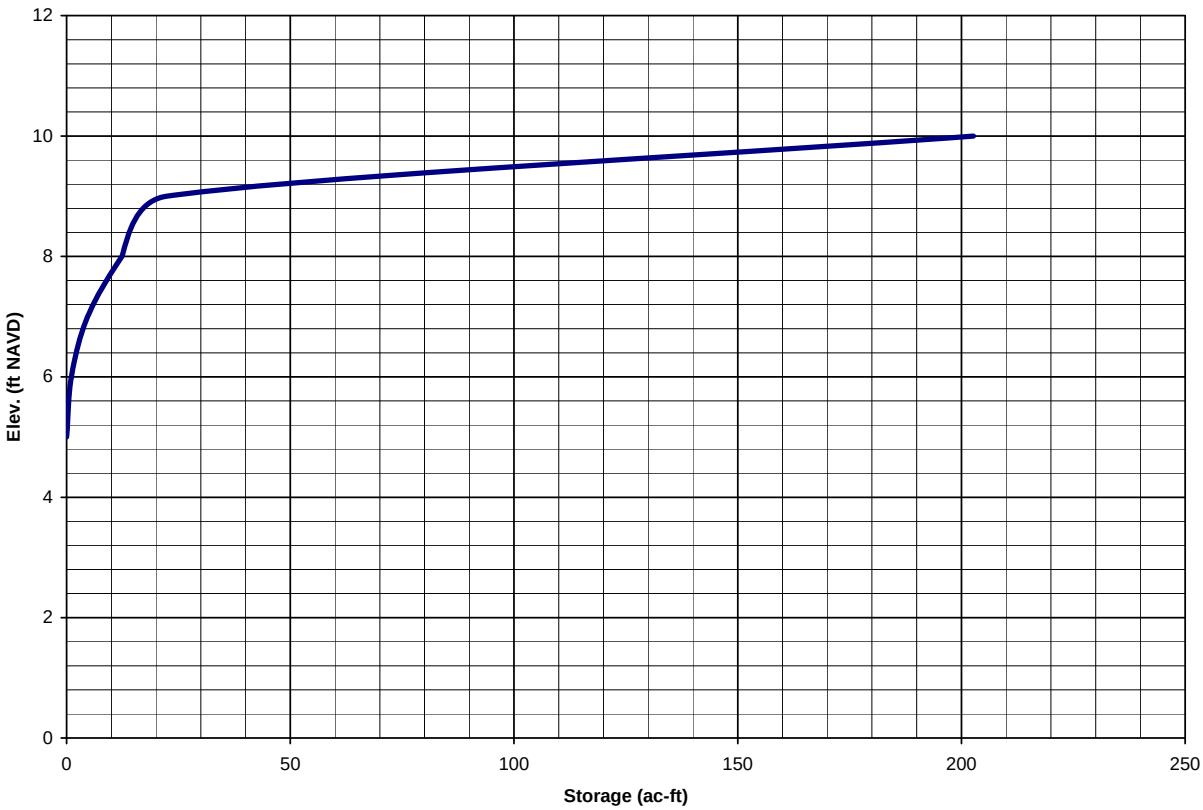


Figure 8. Storage-Elevation Relationship for Charleston Detention Pond

Pump #	Capacity (cfs)	On Level (ft NAVD)
1	8.3	no backup
2	38.5	5.1
3	38.5	6.0

The maximum predicted stage in the detention pond is 9.1 feet with a peak overflow of 6 cfs. (With the small pump in operation, there is no overflow.) The 100-year coincident runoff is primarily contained within the pond at an elevation less than the one-percent stillwater tide, which is 11 feet NAVD. The small overflow would be contained within the ditch that runs behind the west creek levee to Crittenden Pump Station, and is also masked by 100-year tidal inundation.

Crittenden Pump Station Outfall. The pump station discharge is located at Station 69+85 on the west bank. Pertinent basin parameters are provided below. Computations for the hydrograph shown in Figure 9 are provided in Appendix C. Times of concentration and hydraulic grades are calculated by Spreadsheet C.4.

<u>Storm Drain Outfall</u>

Basin Area = 43.0 acres (0.07 mi^2)

Net C = 0.69

Initial t_c = 10 minutes roof to gutter + 200′ pavement at 1% slope = 14.1 minutes

Basin t_c = 44.0 minutes = 0.73 hour; Set R / t +R = 0.5; R = 0.73

Percent Impervious Cover = 59

<u>Area Directly Tributary to Detention Pond</u>

Basin Area = 101.76 acres (0.16 mi^2)

Basin t_c = 3,170′ open space (fallow) at 0.2% slope = 82 min. = 1.37 hour
Set R / t + R = 0.65 (rural); R = 2.54

Percent Impervious Cover = 5

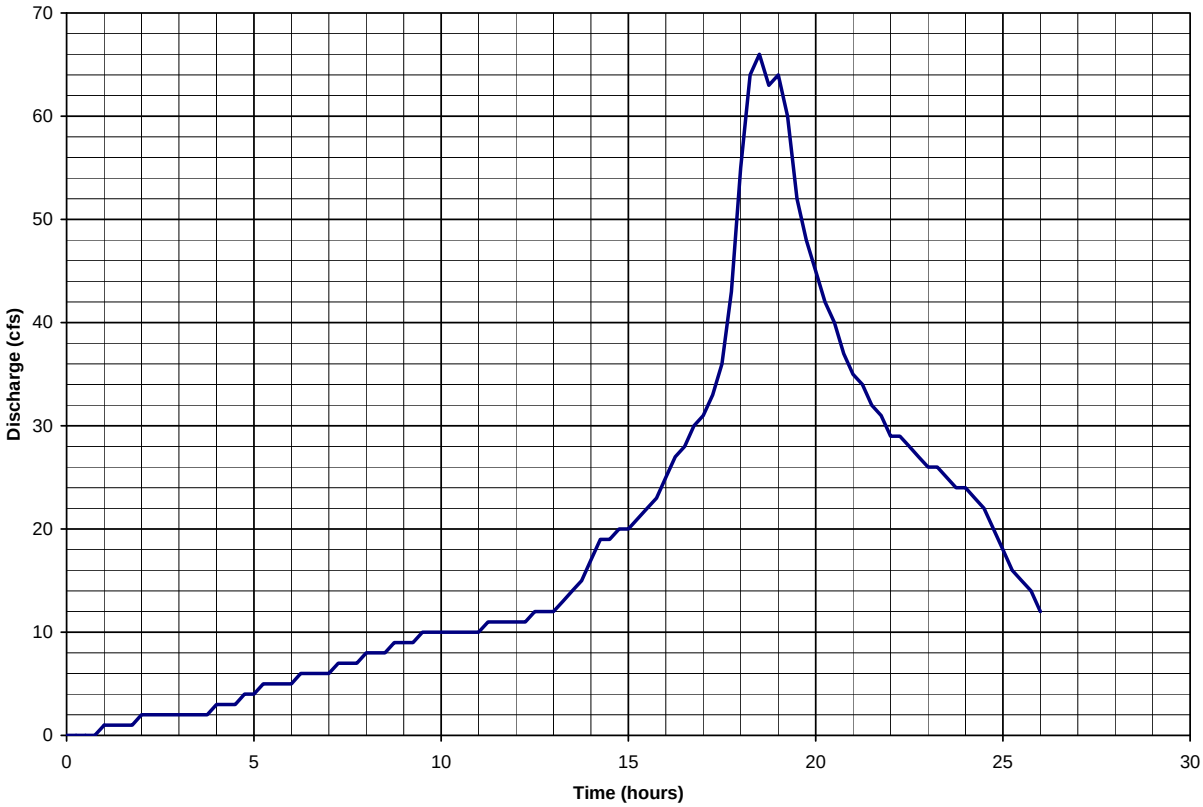


Figure 9. Coincident Interior Hydrograph to Crittenden Pump Station

The Crittenden Pump Station has three large (200-hp) electrical pumps and a smaller electric jockey pump which discharge into Stevens Creek. There is a diesel generator on-site to provide emergency backup power and the station is fully automatic. The pump station was constructed to provide for the relatively easy installation of an additional fourth large pump if there should ever be a need to provide additional pumping capacity. Total pump station capacity with three pumps is 150 cfs, which is more than double the estimated one-percent inflow of 66 cfs. Therefore there is no residual ponding at Crittenden Pump Station. As demonstrated by Spreadsheet C.4, there is sufficient pipe capacity to deliver stormwater runoff to the pump station without interior flooding.

RESIDUAL FLOODPLAIN MAPPING

Outboard levees protecting the interior area are not certified to NFIP standards, yet they generally provide protection against inundation from high tides in San Francisco Bay. If the outboard levees hold, each of the major interior drainage facilities has sufficient capacity to discharge the coincident interior runoff hydrograph to Stevens Creek without residual ponding. If the outboard levees do not hold (or more to the point, are not recognized by FEMA without certification), the area is inundated to elevation 11 feet NAVD, which represents the one-percent stillwater surge in San Francisco Bay. While this inundation appears to flood both pump stations, rendering them inoperable, the non-operational status of the pumps would not affect tidal inundation and the final FIRM should show areas mapped to 11 feet NAVD using the most recent LiDAR generated topography. (See tidal mapping attached as Figure E.2.)

It may also be noted that these findings are consistent with the City of Mountain View "Citywide Storm Drainage Master Plan" (Nolte, 2005), which does not indicate areas of residual flooding within the Stevens Creek interior drainage area.

IMPACT TO STEVENS CREEK DISCHARGE

Figure 10 shows coincident interior discharge to Stevens Creek at each outfall location. Stevens Creek discharge at Highway 101 peaks at 19.5 hours, so discharge from both pump stations (assuming all pumps in operation) is coincident to peak discharge in the creek. Discharge from the La Avenida Street gravity outfall occurs before the Stevens Creek peak. Relative to Stevens Creek discharge (5,750 cfs), the combined coincident peak discharge from interior areas is relatively small. At the peak discharge of Stevens Creek (19.5 hours), the combined interior runoff is 160 cfs (three percent of the creek discharge); when the combined interior runoff is at its peak of 220 cfs (18 hours), the creek discharge is 3,970 cfs. Stevens Creek discharge is not shown on Figure 10 due to its relative scale.

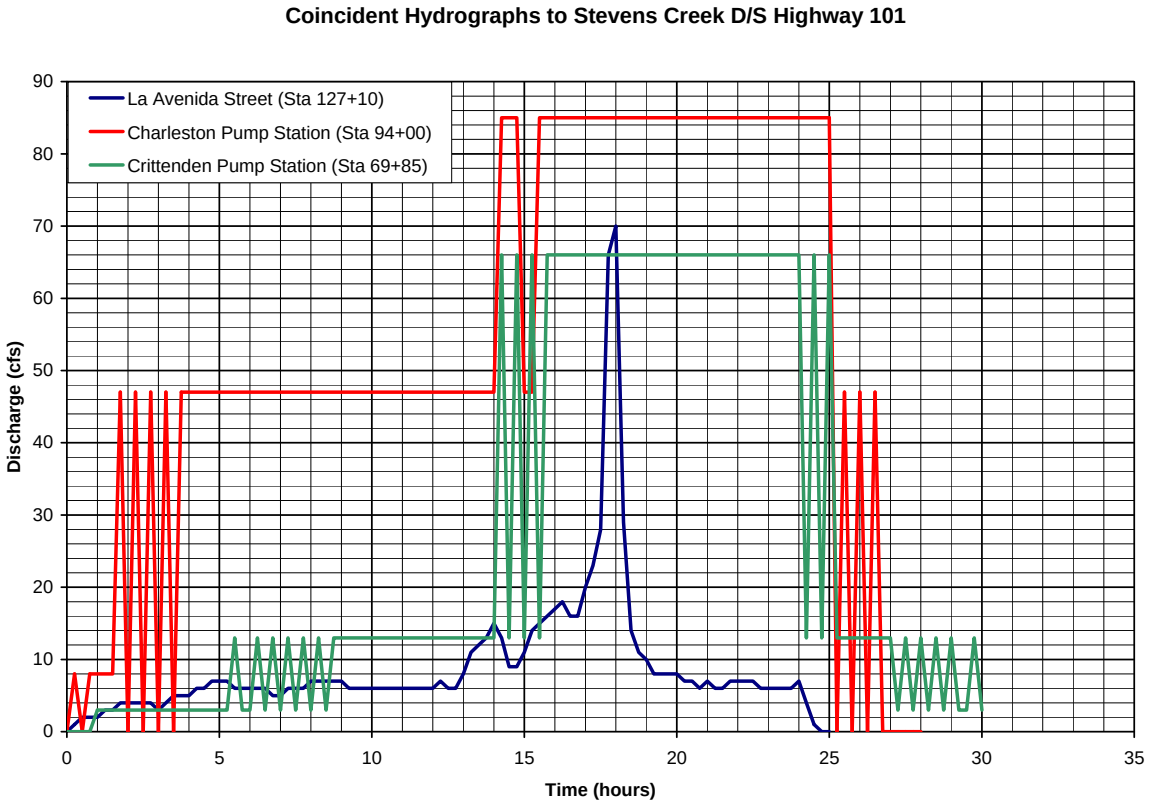


Figure 10. Coincident Interior Discharge to Stevens Creek

Appendix A

FIS Archive Information

Precipitation Patterns

100-year Hydrograph for Stevens Creek

P-1

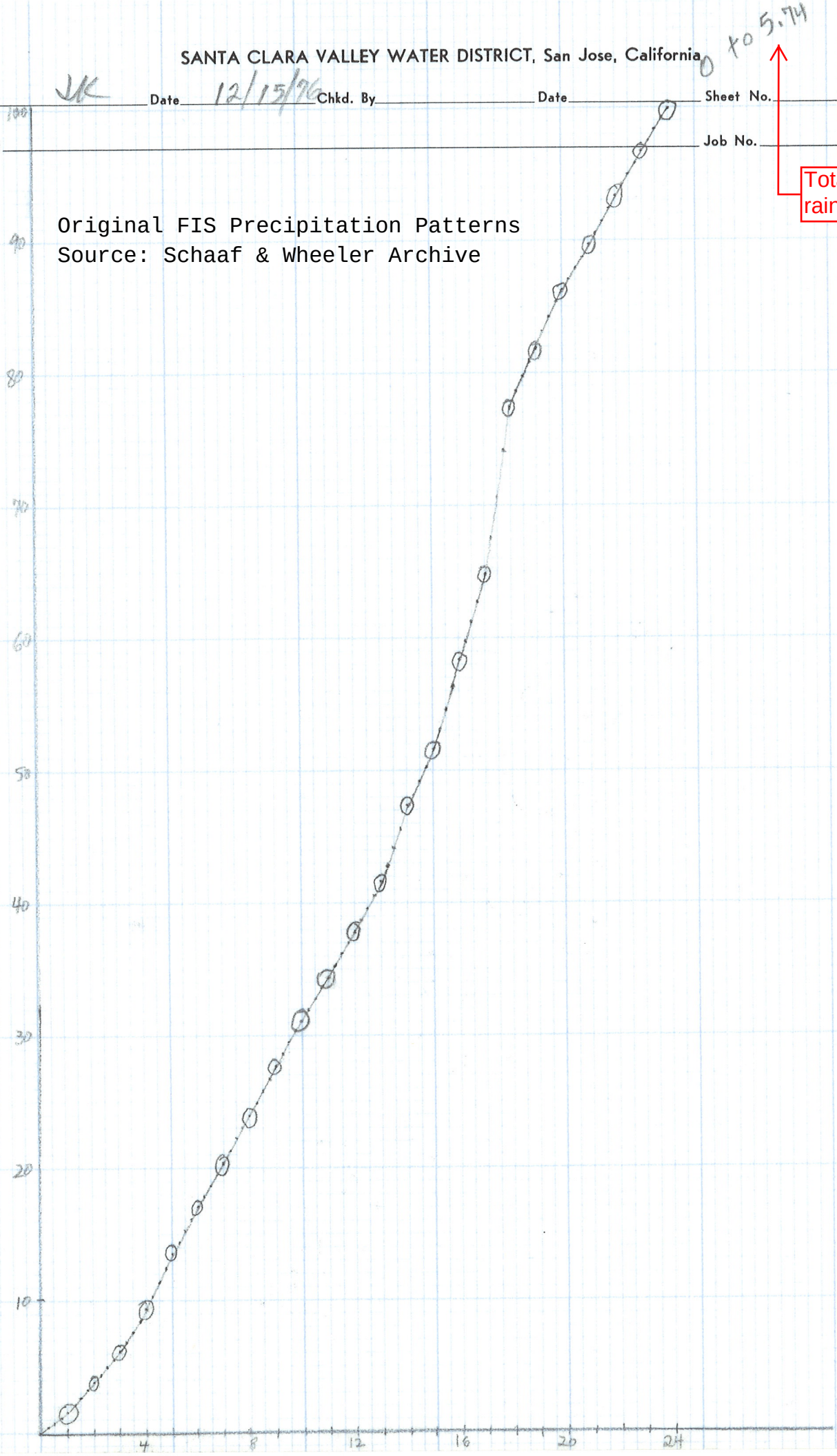
SANTA CLARA VALLEY WATER DISTRICT, San Jose, California

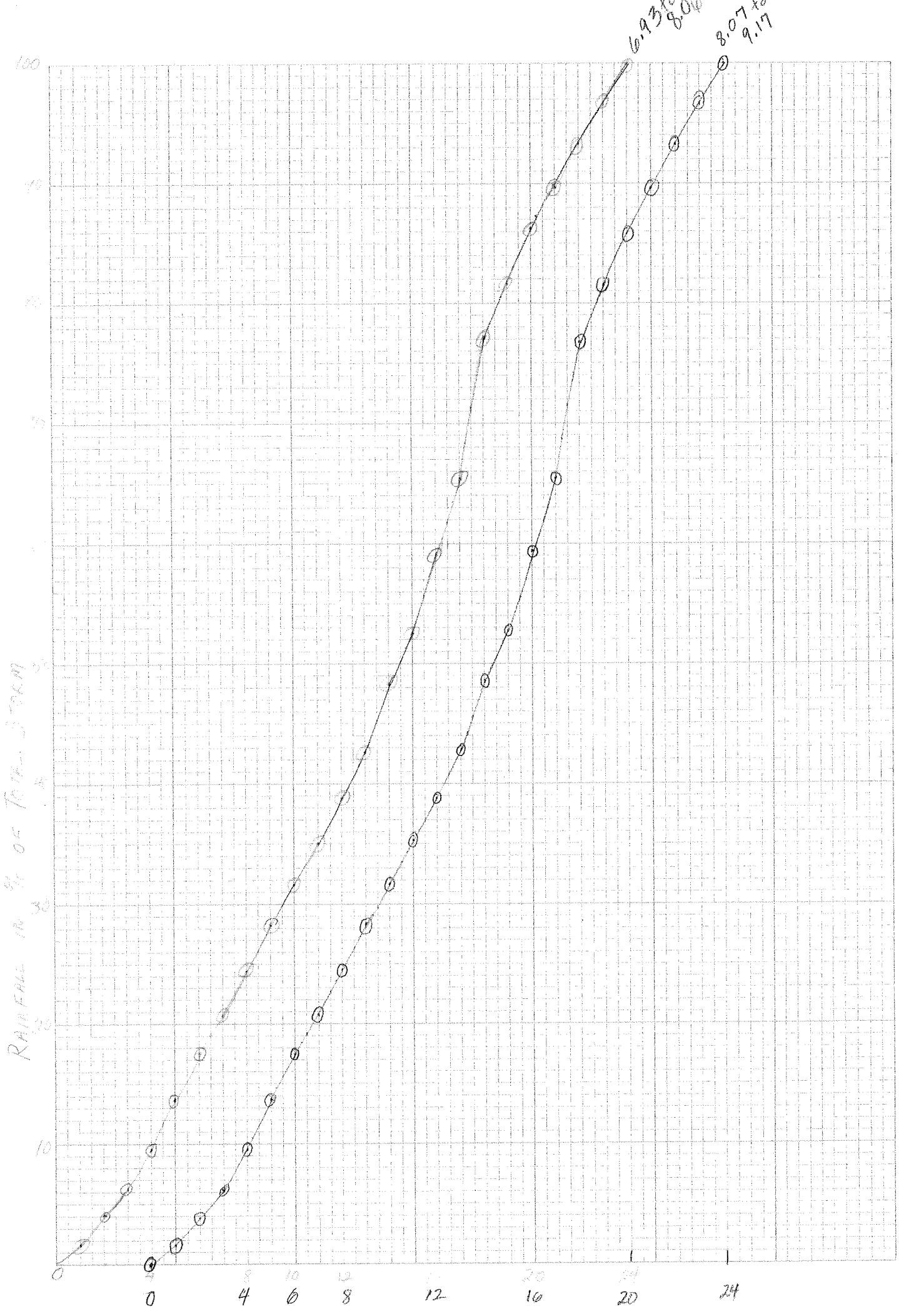
By JK Date 12/15/96 Chkd. By _____ Date _____ Sheet No. _____ of _____

Subject _____ Job No. _____

Total 24 hour rainfall depth.

Original FIS Precipitation Patterns
Source: Schaaf & Wheeler Archive





CLEARPRINT PAPER CO. NO. C3190. 10 DIVISIONS PER INCH BOTH WAYS 70 X 90 DIVISIONS. PRINTED IN U.S.A. ON CLEARPRINT TECHNICAL PAPER NO. 1015

FIS Precipitation Pattern
Source: FEMA Microfishe

```
*************************
C-1 VERSION DATED JAN 1973
DATED AUG 74
ANGE NO. 01
*************************
          STEVENS CK HYDROLOGY 100YR
             RESERVOIR AT 1500 AC-FT
          SCVWD

                          JOB SPECIFICATION
                NC   NHR  NMIN  IDAY   IHR  IMIN METRC  IPLT  IPRT NSTAN
               125     0    15     0     0     0     0     0     0     0
                                JOPER   NWT
                                    1     0

*********          **********          **********          **********          **********

                     SUB-AREA RUNOFF COMPUTATION

        RUNOFF HYDROGRAPH 57-12
                    ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME
                       12       0       0       0       0       0       1

                          HYDROGRAPH DATA
          IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
              0       0   17.30     0.0     0.0     0.0     0.0       0       0       0

                            PRECIP DATA
                      NP   STORM     DAJ     DAK
                      96   10.63     0.0     0.0
                          PRECIP PATTERN
    0.29    0.36    0.50    0.53    0.68    0.62    0.66    0.40    0.78    0.41
    0.44    0.39    1.12    0.91    0.80    0.71    1.07    1.08    1.10    0.97
    0.98    0.88    0.71    1.14    0.82    0.72    0.81    1.02    1.02    1.04
    0.94    0.88    1.09    0.96    0.81    0.85    0.88    0.87    0.94    0.85
    0.94    0.93    0.92    0.75    0.97    0.88    1.06    0.97    1.22    1.21
    1.05    0.57    1.53    1.43    1.56    1.38    1.03    0.85    1.19    0.98
    3.11    1.55    1.61    0.97    1.63    1.72    1.84    0.88    3.67    2.24
    2.25    3.66    1.46    0.98    1.18    1.01    1.75    0.89    0.95    0.97
    1.24    0.74    1.05    0.85    1.07    1.26    0.85    0.76    1.34    0.73
    0.76    0.69    0.79    0.76    0.85    0.97

                            LOSS DATA
          STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
            0.0     0.0    1.00     0.0     0.0    1.00     0.0    0.13     0.0     0.0

                        UNIT HYDROGRAPH DATA
                    TC=  2.50     R=  1.90     NTA=  0

                          RECESSION DATA
                STRTQ=     0.0     QRCSN=     0.0     RTIOR= 1.00

IHC2081 IBCOM - PROGRAM INTERRUPT (P) -  UNDERFLOW   OLD PSW IS  FFA5000D9216E4F2 . REGISTER CONTAINED   7E19CE07CA4D2000

TRACEBACK  ROUTINE  CALLED FROM ISN   REG.  14   REG.  15   REG.   0   REG.   1

          RUNOF          C07C    4216A91E   0016D140   00000000   00000000
```

#47

STEVENS CREEK ROUTING 100-YEAR FLOOD

ROUTE TO SPRR *****

MODIFIED PULS ROUTING

STORAGE-DISCHARGE TABLE

-21.0	-1000.0	21.0	1000.0	57.0	4000.0	117.0	9000.0	177.0	14000.0

MAX STORAGE = 96.05 ACRE-FEET

ROUTED HYDROGRAPH Q1

0.0	12.4	38.6	77.7	123.6	170.7	220.1	279.4	353.6	440.2
529.4	610.6	680.5	743.5	806.0	873.6	951.9	1065.0	1227.9	1394.6
1551.9	1705.1	1842.4	1949.5	2013.7	2043.9	2054.9	2050.2	2023.4	1985.0
1962.1	1965.0	1977.8	1987.7	1995.8	2005.8	2017.2	2024.1	2020.3	2009.4
2003.9	2009.1	2018.6	2026.8	2037.4	2058.3	2092.5	2129.9	2153.9	2161.4
2165.6	2178.6	2201.2	2236.5	2294.3	2369.7	2438.3	2481.4	2505.1	2527.7
2553.4	2578.9	2613.0	2672.9	2755.0	2836.6	2903.5	2951.4	2983.6	3025.6
3138.9	3375.2	3725.6	4143.1	4565.8	4943.9	5269.4	5563.7	5836.5	6105.8
6388.1	6662.5	6903.8	7091.7	7210.2	7254.6	7237.0	7173.2	7067.7	6919.2
6727.6	6493.7	6227.1	5946.1	5667.0	5401.6	5150.6	4895.4	4615.2	4314.8
4021.7	3755.9	3521.4	3316.6	3135.9	2970.7	2815.2	2666.0	2519.7	2373.7
2225.2	2075.9	1929.4	1786.3	1646.8	1512.6	1385.3	1265.9	1154.4	1056.0
987.0	938.3	876.5	811.1	747.0	686.8	631.5	581.7	537.6	499.6
467.9	442.3	422.3	407.0	395.5	387.1	381.1	376.8	373.8	371.7
370.3	369.4	368.9	368.5	368.3	368.2	368.1	368.1	368.0	368.0
367.9	367.1	365.2	361.9	357.4	352.1	346.3	340.1	333.8	327.4
321.0	314.7	308.4	302.3	296.2	290.3	284.5	278.8	273.2	267.8
262.4	257.2	252.0	247.0	242.0	237.2	232.5	227.8	223.3	218.8

READ STORM DRAIN INFLOW AT SPRR *****

HYDROGRAPH SCSP 3 READ IN WITH 110 VALUES

4.0	5.0	15.0	19.0	23.0	29.0	34.0	39.0	42.0	43.0
44.0	44.0	45.0	50.0	55.0	60.0	65.0	72.0	79.0	85.0
91.0	92.0	90.0	89.0	88.0	85.0	82.0	79.0	77.0	79.0
81.0	82.0	84.0	85.0	86.0	87.0	86.0	83.0	82.0	82.0
81.0	80.0	80.0	78.0	76.0	76.0	78.0	79.0	81.0	81.0
80.0	82.0	88.0	97.0	107.0	116.0	120.0	118.0	111.0	109.0
116.0	120.0	121.0	121.0	122.0	122.0	123.0	124.0	125.0	128.0
135.0	143.0	148.0	151.0	152.0	152.0	150.0	148.0	146.0	143.0
140.0	132.0	124.0	117.0	110.0	104.0	100.0	102.0	103.0	102.0
99.0	98.0	96.0	92.0	90.0	91.0	86.0	71.0	51.0	38.0
29.0	24.0	19.0	15.0	13.0	10.0	9.0	8.0	7.0	7.0

ADD TO CHANNEL = TOTAL FLOW U/S OF SPRR *****

NEW Q1 HYDROGRAPH

4.0	20.4	53.6	96.7	146.6	199.7	254.1	318.4	395.6	483.2
573.4	654.6	725.5	793.5	861.0	933.6	1016.9	1137.0	1306.9	1479.6
1642.9	1797.1	1932.4	2037.5	2101.7	2126.9	2136.9	2129.2	2100.4	2064.0
2043.1	2047.0	2061.8	2072.7	2081.8	2092.8	2103.2	2107.1	2102.3	2091.4
2084.9	2089.1	2098.6	2104.8	2113.4	2134.3	2170.5	2209.9	2234.9	2242.4
2245.6	2260.6	2289.2	2333.5	2401.3	2485.7	2558.3	2599.4	2616.1	2636.7
2669.4	2698.9	2734.0	2793.9	2877.0	2958.6	3026.5	3075.4	3108.6	3153.6
3273.9	3518.2	3873.6	4294.1	4717.8	5095.9	5419.4	5711.7	5982.5	6248.8
6528.1	6794.5	7027.8	7208.7	7320.2	7358.6	7337.0	7275.2	7170.7	7021.2

FIS Hydrographs
Source: Microfishe

6826.6	6591.7	6323.1	6038.1	5757.0	5492.6	5236.6	4966.4	4666.2	4352.8
4050.7	3779.9	3540.4	3331.6	3148.9	2980.7	2834.2	2674.0	2526.7	2380.7
2225.2	2075.9	1929.6	1786.1	1646.8	1512.6	1385.3	1265.9	1154.4	1056.0
987.0	938.3	878.5	811.1	747.0	686.8	631.5	581.7	537.6	499.6
467.9	442.8	422.3	407.0	395.5	387.1	381.1	376.8	373.8	371.9
370.3	369.4	368.9	368.5	368.3	368.2	368.1	368.1	368.0	368.0
367.9	367.1	365.2	361.9	357.4	352.1	346.3	340.1	333.8	327.4
321.0	314.7	308.4	302.3	296.2	290.3	284.5	278.8	273.2	267.8
262.4	257.2	252.0	247.0	242.0	237.2	232.5	227.8	223.3	218.8

2

STEVENS CREEK ROUTING 100-YEAR FLOOD

CAPACITY OF SPEE BRIDGE = 5350 CFS

CHANNEL ROUTING

V = 10.0 F/S LENGTH = 1.0 FT TIME BETWEEN POINTS = 15.00 MIN
CAPACITY =5350.0 CFS IPWR =0 MUSKINGUM X = 0.0
FOR FLOW IN EXCESS OF CAPACITY :
BANK USED TO STORE HYDROGRAPH IN EXCESS OF CAPACITY = 0 ITERATION NO. =3

XI= 0.000 CONTINUITY ROUTING

CHANNEL CAPACITY = 5350.0 CFS

OUTFLOW VOLUME = 504.83 ACRE-FEET

HDROGRAPH IS BELOW

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	69.4	361.7	832.5	898.8
1178.1	1444.5	1677.8	1858.7	1970.2	2008.6	1987.0	1925.2	1820.7	1671.2
1476.6	1241.7	973.1	688.1	407.0	142.6	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

MAX. STORAGE = 0.01 ACRE-FT

ROUTED HYDROGRAPH Q1.

4.0	20.4	53.6	96.7	146.6	199.7	254.1	318.4	395.6	483.2
573.4	654.6	725.5	793.5	860.9	933.6	1016.9	1136.9	1306.9	1479.6
1642.9	1797.1	1932.4	2037.5	2101.7	2128.9	2136.9	2129.2	2100.4	2064.1
2043.1	2047.0	2061.8	2072.7	2081.8	2092.8	2103.2	2107.1	2102.3	2091.4
2084.9	2089.1	2098.6	2104.8	2113.4	2134.3	2170.5	2208.8	2234.9	2242.4
2245.6	2260.6	2289.2	2333.5	2401.3	2485.7	2558.3	2599.4	2616.1	2636.7
2669.4	2698.9	2734.0	2793.9	2877.0	2958.6	3026.5	3075.4	3108.6	3153.6
3273.8	3518.1	3873.5	4294.1	4717.7	5095.8	5350.0	5350.0	5350.0	5350.0
5350.0	5350.0	5350.0	5350.0	5350.0	5350.0	5350.0	5350.0	5350.0	5350.0
5350.0	5350.0	5350.0	5350.0	5350.0	5350.0	5236.7	4966.4	4666.2	4352.9
4050.7	3780.0	3540.5	3331.6	3148.9	2980.7	2824.3	2674.0	2526.7	2380.7
2225.2	2075.9	1929.4	1786.4	1646.8	1512.6	1385.3	1265.9	1154.4	1056.1
987.0	938.3	876.5	811.1	747.1	686.8	631.5	581.7	537.6	499.6
467.9	442.3	422.3	407.6	395.5	387.1	381.1	376.8	373.8	371.7
370.3	369.4	368.9	368.5	368.3	368.2	368.1	368.1	368.0	368.0
367.9	367.1	365.2	361.9	357.4	352.1	346.3	340.1	333.8	327.4
321.0	314.7	308.4	302.2	296.2	290.3	284.5	278.8	273.2	267.8
262.4	257.2	252.0	247.0	242.0	237.2	232.5	227.8	223.3	218.8

MODIFIED PULS ROUTING

STORAGE-DISCHARGE TABLE

-21.0	-1000.0	21.0	1000.0	57.0	4000.0	117.0	9000.0

MAX STORAGE = 73.20 ACRE-FEET

ROUTED HYDROGRAPH Q1

0.0	8.0	27.1	58.8	100.3	148.3	200.1	256.9	322.9	399.7
484.5	569.9	649.2	721.9	791.4	861.2	936.4	1040.8	1208.4	1379.4
1547.7	1707.1	1853.0	1975.1	2062.5	2111.3	2131.3	2132.9	2116.1	2084.8
2055.9	2045.8	2053.8	2066.2	2076.4	2086.5	2097.2	2104.6	2104.7	2097.4
2088.9	2087.2	2093.4	2101.1	2108.5	2122.7	2150.2	2186.7	2219.3	2237.2
2243.5	2252.4	2273.2	2308.5	2363.0	2437.5	2515.7	2574.1	2605.2	2624.8
2650.9	2681.7	2713.9	2760.2	2829.8	2911.2	2986.5	3046.1	3088.6	3127.9
3207.3	3381.9	3672.4	4053.0	4472.0	4874.3	5196.8	5338.5	5349.1	5349.9
5350.0	5350.0	5350.0	5350.0	5350.0	5350.0	5350.0	5350.0	5350.0	5350.0
5350.0	5350.0	5350.0	5350.0	5350.0	5350.0	5297.6	5116.2	4838.8	4534.2
4226.6	3938.6	3681.0	3454.3	3256.3	3079.1	2915.7	2761.6	2612.4	2465.6
2315.1	2162.8	2014.6	1869.6	1728.0	1590.8	1459.6	1335.6	1219.5	1113.8
1028.4	976.9	931.1	873.5	811.3	749.0	689.8	634.9	585.3	541.3
503.4	471.5	445.7	425.2	409.4	397.5	388.7	382.2	377.7	374.4
372.2	370.7	369.7	369.0	368.6	368.4	368.2	368.1	368.1	368.1
368.0	367.7	366.7	364.6	361.3	357.0	351.9	346.1	340.1	333.8
327.5	321.1	314.8	308.6	302.4	296.4	290.5	284.7	279.0	273.4
267.9	262.6	257.3	252.2	247.1	242.2	237.3	232.6	227.9	223.4
218.9	214.5	210.2	206.0	201.9	197.9	193.9	190.0	186.2	182.5

READ STORM DRAIN INFLOW AT BAYSHORE FREEWAY *****

HYDROGRAPH SCHF 3 READ IN WITH 110 VALUES

9.0	9.0	30.0	47.0 1	56.0	60.0 4	85.0	98.0 2	109.0	115.0
118.0	119.0 3	119.0	125.0	141.0	155.0	167.0	184.0	203.0	220.0 5
239.0	252.0	248.0	242.0 6	239.0	235.0	227.0	218.0 7	210.0	209.0
216.0	219.0 8	223.0	228.0	231.0	233.0 9	235.0	230.0	222.0	223.0 10
222.0	217.0	216.0	215.0 11	209.0	204.0	208.0	213.0 12	216.0	220.0
219.0	216.0 13	226.0	249.0	274.0	299.0 14	332.0	343.0	313.0	289.0 15
299.0	331.0	362.0	384.0 16	411.0	435.0	428.0	413.0 17	438.0	588.0
590.0	590.0 18	590.0	590.0	553.0	504.0 19	457.0	414.0	373.0	339.0 20
313.0	286.0	264.0	250.0 21	241.0	229.0	214.0	218.0 22	226.0	229.0
226.0	221.0 23	220.0	215.0	207.0	207.0 24	213.0	192.0	134.0	85.0 25
60.0	44.0	32.0	22.0 26	13.0	7.0	2.0	1.0	0.0	0.0

Peak 17.75 – 18.5 hr

ADD TO CHANNEL = TOTAL FLOW AT US101 *****

NEW Q1 HYDROGRAPH

9.0	17.0	57.1	105.8 1	156.3	208.3	285.1	354.9 2	431.9	514.7
602.5	688.9 3	768.2	843.9	932.4	1016.2 4	1103.4	1224.8	1411.4	1599.4 5
1786.7	1959.1	2101.0	2217.1 6	2301.5	2346.3	2358.3	2350.9 7	2326.1	2293.8
2271.9	2264.8 8	2276.8	2294.2	2307.4	2319.5 9	2332.2	2334.6	2326.7	2320.4 10
2310.9	2304.2	2309.4	2316.1 11	2317.5	2326.7	2358.2	2399.7 12	2435.3	2457.2
2462.5	2468.4 13	2499.2	2557.5	2637.0	2736.5 14	2847.7	2917.1	2918.2	2913.8 15
2949.9	3012.7	3075.9	3144.2 16	3240.8	3346.2	3414.5	3459.1 17	3526.6	3715.9
3797.3	3971.9 18	4262.4	4643.0	5025.0	5278.3 19	5653.8	5752.5	5722.1	5688.9

Peak 19.5 hr

5663.0	5636.0	5614.0	5600.0	5591.0	5579.0	5564.0	5568.0	5576.0	5579.0
5576.0	5571.0	5570.0	5565.0	5557.0	5557.0	5510.6	5308.2	4972.8	4619.2
4286.4	3962.6	3713.0	3476.3	3269.3	3086.1	2917.7	2762.6	2612.4	2465.6
2315.1	2162.8	2014.6	1869.6	1728.0	1590.8	1459.6	1335.6	1219.5	1113.8
1020.4	936.9	931.1	873.5	811.3	749.0	689.8	634.9	585.3	541.3
503.4	471.5	445.7	425.2	409.4	397.5	388.7	382.2	377.7	374.4
372.2	370.7	369.7	369.0	368.6	368.4	368.2	368.1	368.1	368.1
368.0	367.7	366.7	364.6	361.3	357.0	351.9	346.1	340.1	333.8
327.5	321.3	314.8	308.6	302.4	296.4	290.5	284.7	279.0	273.4
267.9	262.4	257.3	252.2	247.1	242.2	237.3	232.6	227.9	223.4
218.9	214.5	210.2	206.0	201.9	197.9	193.9	190.0	186.2	182.5

Appendix B

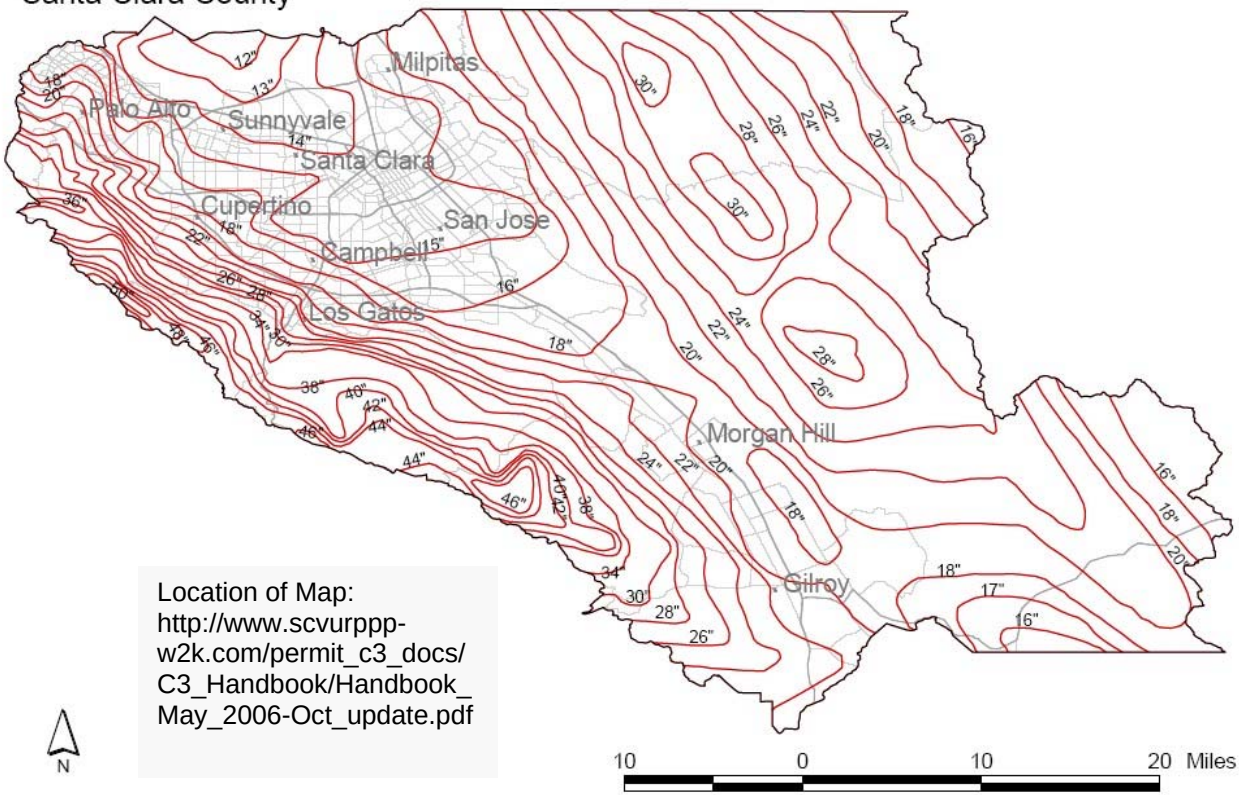
Figures and Tables
Extracted from Santa Clara County Drainage Manual

Mean Annual Precipitation Map

TDS Precipitation Depth Tables

Overland Flow Velocity

Figure A-2
Mean Annual Precipitation Map
Santa Clara County



SOURCE: Santa Clara Valley Water District, Mean Annual Precipitation Map, San Francisco & Monterey Bay Region, 1998

Figure A-2: Mean Annual Precipitation, Santa Clara County

Table B-1: Parameters $A_{T,D}$ and $B_{T,D}$ for TDS Equation

2-YR RETURN PERIOD		
5-min	0.120194	0.001385
10-min	0.166507	0.001956
15-min	0.176618	0.003181
30-min	0.212497	0.005950
1-hr	0.253885	0.010792
2-hr	0.330848	0.019418
3-hr	0.374053	0.027327
6-hr	0.425178	0.045735
12-hr	0.409397	0.069267
24-hr	0.314185	0.096343
48-hr	0.444080	0.134537
72-hr	0.447104	0.159461
5-YR RETURN PERIOD		
5-min	0.170347	0.001857
10-min	0.228482	0.002758
15-min	0.250029	0.004036
30-min	0.307588	0.007082
1-hr	0.357109	0.013400
2-hr	0.451840	0.024242
3-hr	0.512583	0.034359
6-hr	0.554937	0.060859
12-hr	0.562227	0.094871
24-hr	0.474528	0.136056
48-hr	0.692427	0.187173
72-hr	0.673277	0.224003
10-YR RETURN PERIOD		
5-min	0.201876	0.002063
10-min	0.258682	0.003569
15-min	0.294808	0.004710
30-min	0.367861	0.007879
1-hr	0.427723	0.014802
2-hr	0.522608	0.027457
3-hr	0.591660	0.038944
6-hr	0.625054	0.070715
12-hr	0.641638	0.111660
24-hr	0.567017	0.162550
48-hr	0.832445	0.221820
72-hr	0.810509	0.265469

Table B-2: Parameters $A_{T,D}$ and $B_{T,D}$ for TDS Equation

Return Period/Duration	$A_{T,D}$	$B_{T,D}$
25-YR RETURN PERIOD		
5-min	0.230641	0.002691
10-min	0.287566	0.004930
15-min	0.348021	0.005594
30-min	0.443761	0.008719
1-hr	0.508791	0.016680
2-hr	0.612629	0.031025
3-hr	0.689252	0.044264
6-hr	0.693566	0.083195
12-hr	0.725892	0.132326
24-hr	0.675008	0.195496
48-hr	0.989588	0.264703
72-hr	0.967854	0.316424
50-YR RETURN PERIOD		
5-min	0.249324	0.003241
10-min	0.300971	0.006161
15-min	0.384016	0.006315
30-min	0.496301	0.009417
1-hr	0.568345	0.017953
2-hr	0.672662	0.033694
3-hr	0.754661	0.048157
6-hr	0.740666	0.092105
12-hr	0.779967	0.147303
24-hr	0.747121	0.219673
48-hr	1.108358	0.295510
72-hr	1.075643	0.353143
100-YR RETURN PERIOD		
5-min	0.269993	0.003580
10-min	0.315263	0.007312
15-min	0.421360	0.006957
30-min	0.553934	0.009857
1-hr	0.626608	0.019201
2-hr	0.732944	0.036193
3-hr	0.816471	0.051981
6-hr	0.776677	0.101053
12-hr	0.821859	0.162184
24-hr	0.814046	0.243391
48-hr	1.210895	0.325943
72-hr	1.175000	0.389038

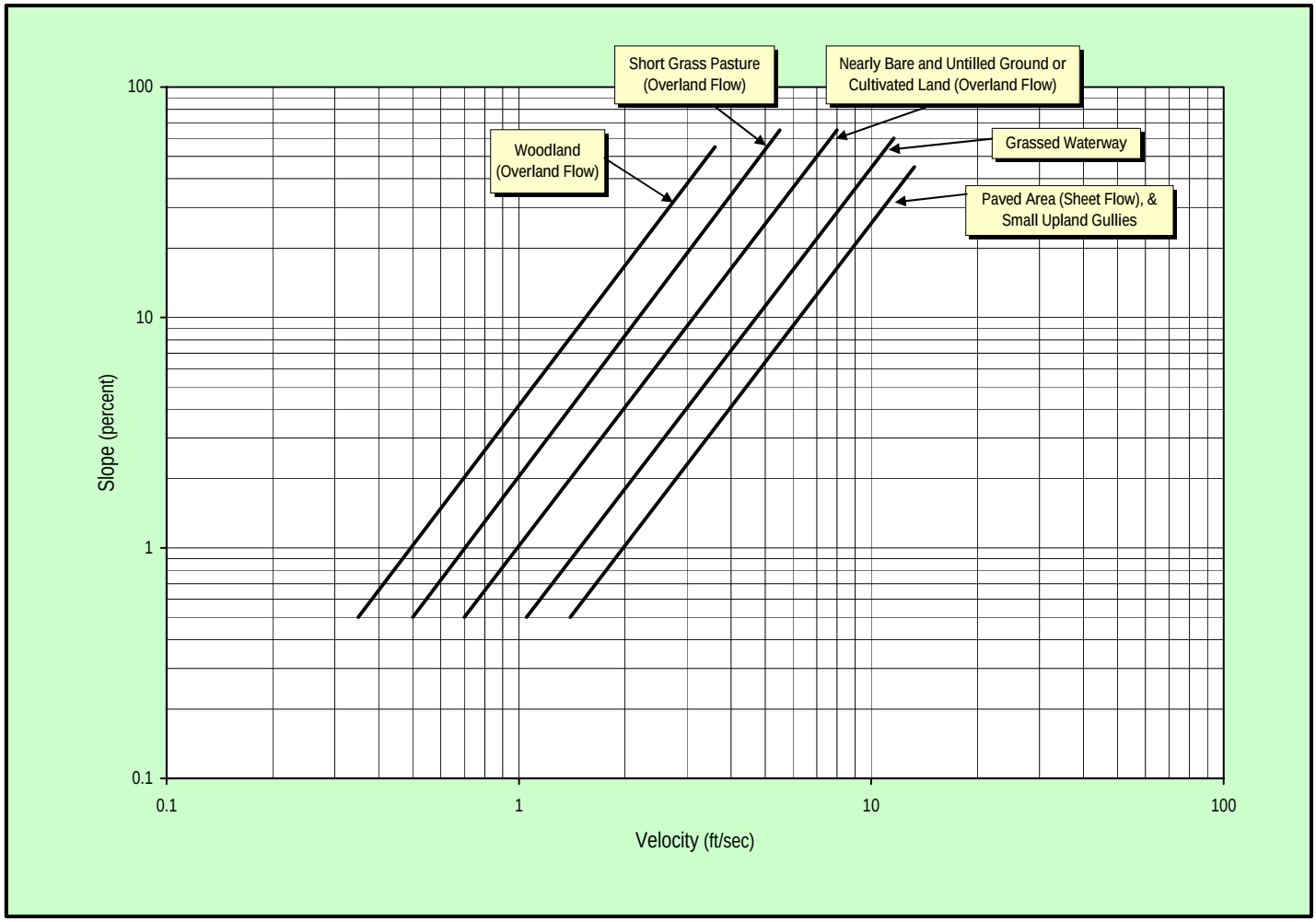


Figure A-1: Overland Flow Velocity

Appendix C

Hydrologic Calculations

Statistical Balance of Rainfall Patterns

La Avenida Street Outfall

Charleston Pump Station

Crittenden Pump Station

Pump Station Information

STATISTICAL BALANCE OF PRECIPITATION

Santa Clara Valley Water District Return Period-Duration-Specific Data

100-year Return Period

MAP =		31 inches		
minutes	hours	A	B	Depth
5	0.08	0.2700	0.0036	0.38
10	0.17	0.3153	0.0073	0.54
15	0.25	0.4214	0.0070	0.64
30	0.50	0.5539	0.0099	0.86
60	1.00	0.6266	0.0192	1.22
120	2.00	0.7329	0.0362	1.85
180	3.00	0.8165	0.0520	2.43
360	6.00	0.7767	0.1011	3.91
720	12.00	0.8219	0.1622	5.85
1440	24.00	0.8140	0.2434	8.36

MAP =		14 inches		
minutes	hours	A	B	Depth
5	0.08	0.2700	0.0036	0.32
10	0.17	0.3153	0.0073	0.42
15	0.25	0.4214	0.0070	0.52
30	0.50	0.5539	0.0099	0.69
60	1.00	0.6266	0.0192	0.90
120	2.00	0.7329	0.0362	1.24
180	3.00	0.8165	0.0520	1.54
360	6.00	0.7767	0.1011	2.19
720	12.00	0.8219	0.1622	3.09
1440	24.00	0.8140	0.2434	4.22

Balance

31-inch MAP				
hours	**depth**	**ratio**	**HB Card**	
1	1.22	0.1462	1462	
2	1.85	0.2219	2219	
3	2.43	0.2904	2904	
6	3.91	0.4677	4677	
24	8.36	1	10000	
minutes				% Total
15	0.64	0.0762		0.0762
30	0.86	0.1028		0.0266
45				0.0217
60	1.22	0.1462		0.0217

Balance

14-inch MAP				
Hours	**Depth**	**Ratio**	**HB Card**	
1	0.90	0.2121	2121	
2	1.24	0.2936	2936	
3	1.54	0.3658	3658	
6	2.19	0.5191	5191	
24	4.22	1	10000	
minutes				% Total
15	0.52	0.1229		0.1229
30	0.69	0.1639		0.0410
45				0.0241
60	0.90	0.2121		0.0241

```
1****************************************                                                    ****************************************
 *                                      *                                                    *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                                    *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998              *                                                    *    HYDROLOGIC ENGINEERING CENTER     *
 *            VERSION 4.1               *                                                    *          609 SECOND STREET           *
 *                                      *                                                    *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   06JAN09  TIME  14:06:48  *                                                    *           (916) 756-1104             *
 *                                      *                                                    *                                      *
 ****************************************                                                    ****************************************


                                                X     X  XXXXXXX   XXXXX           X
                                                X     X  X        X     X         XX
                                                X     X  X        X                X
                                                XXXXXXX  XXXX     X        XXXXX   X
                                                X     X  X        X                X
                                                X     X  X        X     X          X
                                                X     X  XXXXXXX   XXXXX         XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                                   HEC-1 INPUT                                                   PAGE  1

         LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1          ID   SCHAAF & WHEELER CONSULTING CIVIL ENGINEERS
            2          ID   BALANCE 1976 FIS PATTERN TO LOCAL 100-YR STATISTICS
            3          ID   CALIBRATION PATTERN TO SAN FRANCISQUITO CREEK GAGE AT STANFORD (MAP = 31")
            4          IT      15 01JAN01       0     96.
            5          IO       5       0

            6          KK    FIS1
            7          KM   1976 FIS PATTERN FOR 14" MAP (4.22" TOTAL PRECIPITATION)
            8          BA      0.
            9          QI    40.0    35.0    25.0    47.0    53.0    60.0    60.0    62.0    53.0    59.0
           10          QI    51.0    56.0    74.0    75.0    80.0    85.0   104.0    94.0   112.0   113.0
           11          QI    92.0    80.0    90.0    88.0    84.0    76.0    82.0    72.0   103.0    82.0
           12          QI    96.0    95.0    95.0    94.0    93.0    94.0    72.0    92.0    91.0    74.0
           13          QI    93.0    82.0    86.0    68.0    94.0    85.0    89.0    92.0    91.0    78.0
           14          QI    94.0   113.0   123.0   128.0   150.0   170.0    83.0    92.0   105.0   143.0
           15          QI   156.0   156.0   169.0   193.0   162.0   117.0   174.0   206.0   260.0   318.0
           16          QI   333.0   328.0   144.0   111.0   109.0   106.0   107.0   110.0   117.0    89.0
           17          QI    93.0    89.0    82.0   106.0    52.0   104.0    85.0   106.0    86.0    86.0
           18          QI    88.0    85.0    72.0    79.0    94.0    86.0

           19          KK   BAL14
           20          KM   BALANCE TO MAP=14" USING TDS STATISTICS
           21          KM   USE 1-, 2-, 3-, 6-, 24-HR, STATISTICS IN BALANCE CARD
           22          KO       1
           23          HB      4.   2121.      8.   2936.     12.   3658.     24.   5191.     96.  10000.
                       *

           24          KK    FIS1
           25          KM   1976 FIS PATTERN FOR 31" MAP (8.36" TOTAL PRECIPITATION)
           26          BA      0.
           27          QI    35.0    40.0    40.0    48.0    52.0    60.0    45.0    72.0    45.0    53.0
           28          QI    55.0    60.0    75.0    85.0    90.0    94.0   101.0   105.0   108.0   112.0
           29          QI   105.0    95.0    90.0    86.0    84.0    82.0    81.0    80.0   112.0    90.0
           30          QI    85.0    89.0    96.0    85.0    85.0   110.0    80.0    85.0    85.0    94.0
           31          QI   106.0    65.0    85.0    88.0    92.0    94.0    95.0    95.0    96.0    97.0
           32          QI    99.0   101.0   118.0   145.0   150.0   160.0    95.0   105.0   110.0   116.0
           33          QI   130.0   144.0   165.0   200.0   155.0   120.0   165.0   182.0   333.0   290.0
           34          QI   260.0   263.0   117.0   100.0   120.0   131.0   139.0    90.0   105.0    98.0
           35          QI    97.0    95.0    95.0    89.0    91.0    90.0    80.0    83.0   102.0    90.0
           36          QI    85.0    83.0    82.0    80.0    75.0    90.0

           37          KK   BAL31
           38          KM   BALANCE TO MAP=31" USING TDS STATISTICS
           39          KM   USE 1-, 2-, 3-, 6-, 24-HR, STATISTICS IN BALANCE CARD
           40          KO       1
           41          HB      4.   1462.      8.   2219.     12.   2904.     24.   4677.     96.  10000.
           42          ZZ
```

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1*****************************************                                                    *****************************************
 *                                       *                                                    *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                                    *    U.S. ARMY CORPS OF ENGINEERS       *
 *              JUN   1998               *                                                    *    HYDROLOGIC ENGINEERING CENTER      *
 *            VERSION 4.1                *                                                    *          609 SECOND STREET            *
 *                                       *                                                    *       DAVIS, CALIFORNIA 95616         *
 *  RUN DATE   06JAN09  TIME  14:06:48   *                                                    *           (916) 756-1104              *
 *                                       *                                                    *                                       *
 *****************************************                                                    *****************************************


                         SCHAAF & WHEELER CONSULTING CIVIL ENGINEERS
                         BALANCE 1976 FIS PATTERN TO LOCAL 100-YR STATISTICS
                         CALIBRATION PATTERN TO SAN FRANCISQUITO CREEK GAGE AT STANFORD (MAP = 31")

   5 IO          OUTPUT CONTROL VARIABLES
                       IPRNT           5  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                        NMIN          15  MINUTES IN COMPUTATION INTERVAL
                       IDATE      1JAN 1  STARTING DATE
                       ITIME        0000  STARTING TIME
                          NQ          96  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE      1JAN 1  ENDING DATE
                      NDTIME        2345  ENDING TIME
                      ICENT          19  CENTURY MARK

                  COMPUTATION INTERVAL     .25 HOURS
                       TOTAL TIME BASE   23.75 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  19 KK     *     BAL14  *
            *            *
            **************

  22 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           1  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
         BALANCE RESULTS            2121.            2936.            3658.            5191.           10000.
*****************************************************************************************************************************

                                                HYDROGRAPH AT STATION    BAL14
*****************************************************************************************************************************
                                 *                                 *                                 *
   DA MON HRMN  ORD      FLOW    *   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW
                                 *                                 *                                 *
    1 JAN 0000    1       32.    *    1 JAN 0600   25       68.   *    1 JAN 1200   49       73.   *    1 JAN 1800   73      150.
    1 JAN 0015    2       28.    *    1 JAN 0615   26       61.   *    1 JAN 1215   50       63.   *    1 JAN 1815   74      116.
    1 JAN 0030    3       20.    *    1 JAN 0630   27       66.   *    1 JAN 1230   51       76.   *    1 JAN 1830   75      114.
    1 JAN 0045    4       38.    *    1 JAN 0645   28       58.   *    1 JAN 1245   52      118.   *    1 JAN 1845   76       86.
    1 JAN 0100    5       43.    *    1 JAN 0700   29       83.   *    1 JAN 1300   53      128.   *    1 JAN 1900   77       86.
    1 JAN 0115    6       48.    *    1 JAN 0715   30       66.   *    1 JAN 1315   54      133.   *    1 JAN 1915   78       89.
    1 JAN 0130    7       48.    *    1 JAN 0730   31       77.   *    1 JAN 1330   55      156.   *    1 JAN 1930   79       94.
    1 JAN 0145    8       50.    *    1 JAN 0745   32       77.   *    1 JAN 1345   56      177.   *    1 JAN 1945   80       72.
    1 JAN 0200    9       43.    *    1 JAN 0800   33       77.   *    1 JAN 1400   57       86.   *    1 JAN 2000   81       75.
    1 JAN 0215   10       48.    *    1 JAN 0815   34       76.   *    1 JAN 1415   58       96.   *    1 JAN 2015   82       72.
    1 JAN 0230   11       41.    *    1 JAN 0830   35       75.   *    1 JAN 1430   59      109.   *    1 JAN 2030   83       66.
    1 JAN 0245   12       45.    *    1 JAN 0845   36       76.   *    1 JAN 1445   60      149.   *    1 JAN 2045   84       86.
    1 JAN 0300   13       60.    *    1 JAN 0900   37       58.   *    1 JAN 1500   61      167.   *    1 JAN 2100   85       42.
    1 JAN 0315   14       61.    *    1 JAN 0915   38       74.   *    1 JAN 1515   62      167.   *    1 JAN 2115   86       84.
    1 JAN 0330   15       65.    *    1 JAN 0930   39       73.   *    1 JAN 1530   63      181.   *    1 JAN 2130   87       69.
    1 JAN 0345   16       69.    *    1 JAN 0945   40       60.   *    1 JAN 1545   64      207.   *    1 JAN 2145   88       86.
    1 JAN 0400   17       84.    *    1 JAN 1000   41       75.   *    1 JAN 1600   65      200.   *    1 JAN 2200   89       69.
    1 JAN 0415   18       76.    *    1 JAN 1015   42       66.   *    1 JAN 1615   66      145.   *    1 JAN 2215   90       69.
    1 JAN 0430   19       90.    *    1 JAN 1030   43       69.   *    1 JAN 1630   67      215.   *    1 JAN 2230   91       71.
    1 JAN 0445   20       91.    *    1 JAN 1045   44       55.   *    1 JAN 1645   68      255.   *    1 JAN 2245   92       69.
    1 JAN 0500   21       74.    *    1 JAN 1100   45       76.   *    1 JAN 1700   69      445.   *    1 JAN 2300   93       58.
    1 JAN 0515   22       65.    *    1 JAN 1115   46       69.   *    1 JAN 1715   70      544.   *    1 JAN 2315   94       64.
    1 JAN 0530   23       73.    *    1 JAN 1130   47       72.   *    1 JAN 1730   71      570.   *    1 JAN 2330   95       76.
    1 JAN 0545   24       71.    *    1 JAN 1145   48       74.   *    1 JAN 1745   72      561.   *    1 JAN 2345   96       69.
                                 *                                 *                                 *
*****************************************************************************************************************************

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     23.75-HR
+   (CFS)       (HR)
                           (CFS)
```

```
+     570.     17.50                  216.        105.        105.         105.
                         (INCHES)     .000        .000        .000         .000
                          (AC-FT)     107.        206.        206.         206.

                          CUMULATIVE AREA =     .00 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  37 KK     *     BAL31  *
            *            *
            **************

  40 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           1  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
         BALANCE RESULTS            1462.            2219.            2907.            4677.           10000.
*****************************************************************************************************************************************

                                                HYDROGRAPH AT STATION    BAL31

*****************************************************************************************************************************************
                                 *                                 *                                 *
   DA MON HRMN  ORD      FLOW    *   DA MON HRMN  ORD      FLOW    *   DA MON HRMN  ORD      FLOW    *   DA MON HRMN  ORD      FLOW
                                 *                                 *                                 *
    1 JAN 0000    1       31.    *    1 JAN 0600   25       73.    *    1 JAN 1200   49       84.    *    1 JAN 1800   73      139.
    1 JAN 0015    2       35.    *    1 JAN 0615   26       71.    *    1 JAN 1215   50       85.    *    1 JAN 1815   74      119.
    1 JAN 0030    3       35.    *    1 JAN 0630   27       71.    *    1 JAN 1230   51       86.    *    1 JAN 1830   75      143.
    1 JAN 0045    4       42.    *    1 JAN 0645   28       70.    *    1 JAN 1245   52       88.    *    1 JAN 1845   76      156.
    1 JAN 0100    5       45.    *    1 JAN 0700   29       98.    *    1 JAN 1300   53      103.    *    1 JAN 1900   77      165.
    1 JAN 0115    6       52.    *    1 JAN 0715   30       78.    *    1 JAN 1315   54      172.    *    1 JAN 1915   78       78.
    1 JAN 0130    7       39.    *    1 JAN 0730   31       74.    *    1 JAN 1330   55      178.    *    1 JAN 1930   79       92.
    1 JAN 0145    8       63.    *    1 JAN 0745   32       78.    *    1 JAN 1345   56      190.    *    1 JAN 1945   80       85.
    1 JAN 0200    9       39.    *    1 JAN 0800   33       84.    *    1 JAN 1400   57      113.    *    1 JAN 2000   81       85.
    1 JAN 0215   10       46.    *    1 JAN 0815   34       74.    *    1 JAN 1415   58      125.    *    1 JAN 2015   82       83.
    1 JAN 0230   11       48.    *    1 JAN 0830   35       74.    *    1 JAN 1430   59      131.    *    1 JAN 2030   83       83.
    1 JAN 0245   12       52.    *    1 JAN 0845   36       96.    *    1 JAN 1445   60      138.    *    1 JAN 2045   84       78.
    1 JAN 0300   13       65.    *    1 JAN 0900   37       70.    *    1 JAN 1500   61      140.    *    1 JAN 2100   85       79.
    1 JAN 0315   14       74.    *    1 JAN 0915   38       74.    *    1 JAN 1515   62      155.    *    1 JAN 2115   86       78.
    1 JAN 0330   15       78.    *    1 JAN 0930   39       74.    *    1 JAN 1530   63      178.    *    1 JAN 2130   87       70.
    1 JAN 0345   16       82.    *    1 JAN 0945   40       82.    *    1 JAN 1545   64      215.    *    1 JAN 2145   88       72.
    1 JAN 0400   17       88.    *    1 JAN 1000   41       92.    *    1 JAN 1600   65      189.    *    1 JAN 2200   89       89.
    1 JAN 0415   18       92.    *    1 JAN 1015   42       57.    *    1 JAN 1615   66      146.    *    1 JAN 2215   90       78.
    1 JAN 0430   19       94.    *    1 JAN 1030   43       74.    *    1 JAN 1630   67      201.    *    1 JAN 2230   91       74.
    1 JAN 0445   20       98.    *    1 JAN 1045   44       77.    *    1 JAN 1645   68      222.    *    1 JAN 2245   92       72.
    1 JAN 0500   21       92.    *    1 JAN 1100   45       80.    *    1 JAN 1700   69      425.    *    1 JAN 2300   93       71.
    1 JAN 0515   22       83.    *    1 JAN 1115   46       82.    *    1 JAN 1715   70      370.    *    1 JAN 2315   94       70.
    1 JAN 0530   23       78.    *    1 JAN 1130   47       83.    *    1 JAN 1730   71      332.    *    1 JAN 2330   95       65.
    1 JAN 0545   24       75.    *    1 JAN 1145   48       83.    *    1 JAN 1745   72      336.    *    1 JAN 2345   96       78.
                                 *                                 *                                 *
*****************************************************************************************************************************************

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     23.75-HR
+   (CFS)       (HR)
                          (CFS)
+     425.     17.00                  194.        105.        105.         105.
                         (INCHES)     .000        .000        .000         .000
                          (AC-FT)      96.        205.        205.         205.

                          CUMULATIVE AREA =     .00 SQ MI

1
                                                   RUNOFF SUMMARY
                                             FLOW IN CUBIC FEET PER SECOND
                                           TIME IN HOURS,  AREA IN SQUARE MILES

                                       PEAK   TIME OF     AVERAGE FLOW FOR MAXIMUM PERIOD      BASIN     MAXIMUM     TIME OF
         OPERATION       STATION       FLOW    PEAK                                           AREA      STAGE     MAX STAGE
+                                                          6-HOUR     24-HOUR     72-HOUR

         HYDROGRAPH AT
+                          FIS1        333.   17.50         168.        105.        105.        .00

         HYDROGRAPH AT
+                         BAL14        570.   17.50         216.        105.        105.        .00

         HYDROGRAPH AT
+                          FIS1        333.   17.00         162.        105.        105.        .00

         HYDROGRAPH AT
+                         BAL31        425.   17.00         194.        105.        105.        .00


 *** NORMAL END OF HEC-1 ***
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Spreadsheet C.1 La Avenida Street Outfall Time of Concentration Calculations

Intensity (from Santa Clara County Drainage Manual)

Intensity

I = K/t^n
I = Intensity
k = 1.008
MAP = 14
Q = kCiA
100-yr K = 1.02
n = 0.52

Pipe Capacity (Mannings)

Sf = ((Q*n)/(1.49*A*R^(2/3)))^2
V = Q/A
V = Velocity, ft/s
R = hydraulic radius, ft (A/P)
A = cross-sectional flow area, sf (pipe area since assuming flowing full)
P = Wetted perimeter, ft (pipe perimeter since assuming flowing full)
Sf = Friction slope,
n = 0.013

Flow

Q = kCiA
k = 1.008

EGL from coincident stage hydrograph on Stevens Creek

ID/Name	Land Use Coeff	Time of Concentration min	Drainage Area acres	C x A acres	Cumulative C x A acres	100-yr intensity in/hr	100-yr Q cfs	Pipe Length ft	Pipe diam in	Pipe area sf	Pipe P ft	R ft	100-yr Velocity ft/s	Friction Slope ft/ft	Friction Loss feet	Minor Loss feet	EGL ft NAVD
1	0.85	17.00	12.56	10.68	10.68	1.97	21.15	299.00	30	4.91	7.85	0.63	4.31	0.00265	0.79		25.64
1-2																	
2	0.84	18.16	10.55	8.87	19.54	1.90	37.41	256.00	36	7.07	9.42	0.75	5.29	0.00313	0.80		24.85
2-3																	
3	0.84	18.96	4.81	4.04	23.58	1.86	44.13	401.00	36	7.07	9.42	0.75	6.24	0.00435	1.75		24.05
3-4																	
4	0.79	20.03	13.85	10.94	34.52	1.80	62.79	225.00	48	12.57	12.57	1.00	5.00	0.00190	0.43		22.30
4-5																	
5	0.76	20.78	13.38	10.17	44.69	1.77	79.74	150.00	48	12.57	12.57	1.00	6.35	0.00307	0.46		21.87
5-out								15.00	78	33.18	20.42	1.63	2.40	0.00023	0.00	0.09	21.32
			55.15														

INTERIOR RUNOFF HYDROGRAPH AT LA AVENIDA STREET OUTFALL

```
1****************************************                                                    ****************************************
 *                                      *                                                    *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                                    *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998              *                                                    *    HYDROLOGIC ENGINEERING CENTER     *
 *            VERSION 4.1               *                                                    *          609 SECOND STREET           *
 *                                      *                                                    *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   09JAN09  TIME  14:42:42  *                                                    *           (916) 756-1104             *
 *                                      *                                                    *                                      *
 ****************************************                                                    ****************************************
```

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX   XXXXX        XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
1                                                   HEC-1 INPUT                                                   PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

             1          ID   Stevens Creek Hydrograph Routing
             2          ID   Emily Caldwell, Schaaf & Wheeler, November 19, 2008
             3          IT      15 20NOV98       0     120
             4          IO       1
                        *

             5          KK    SOUTHEAST BASIN TO LA AVENIDA OUTFALL
             6          KM    STORM DRAIN HYDROGRAPH
             7          BA    .086
             8          PB    4.22
             9          PI    0.32    0.28    0.20    0.38    0.43    0.48    0.48    0.50    0.43    0.48
            10          PI    0.41    0.45    0.60    0.61    0.65    0.69    0.84    0.76    0.90    0.91
            11          PI    0.74    0.65    0.73    0.71    0.68    0.61    0.66    0.58    0.83    0.66
            12          PI    0.77    0.77    0.77    0.76    0.75    0.76    0.58    0.74    0.73    0.60
            13          PI    0.75    0.66    0.69    0.55    0.76    0.69    0.72    0.74    0.73    0.63
            14          PI    0.76    1.18    1.28    1.33    1.56    1.77    0.86    0.96    1.09    1.49
            15          PI    1.67    1.67    1.81    2.07    2.00    1.45    2.15    2.55    2.41    4.10
            16          PI   12.29    2.41    1.50    1.16    1.14    0.86    0.86    0.89    0.94    0.72
            17          PI    0.75    0.72    0.66    0.86    0.42    0.84    0.69    0.86    0.69    0.69
            18          PI    0.71    0.69    0.58    0.64    0.76    0.71
            19          UC     .35    .039
            20          LS       0      89      84
                        *
            21          ZZ
1****************************************                                                    ****************************************
 *                                      *                                                    *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                                    *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998              *                                                    *    HYDROLOGIC ENGINEERING CENTER     *
 *            VERSION 4.1               *                                                    *          609 SECOND STREET           *
 *                                      *                                                    *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   09JAN09  TIME  14:42:42  *                                                    *           (916) 756-1104             *
 *                                      *                                                    *                                      *
 ****************************************                                                    ****************************************
```

```
                          Stevens Creek Hydrograph Routing
                          Emily Caldwell, Schaaf & Wheeler, November 19, 2008

    4 IO          OUTPUT CONTROL VARIABLES
                        IPRNT           1  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE

      IT          HYDROGRAPH TIME DATA
                         NMIN          15  MINUTES IN COMPUTATION INTERVAL
                        IDATE     20NOV98  STARTING DATE
                        ITIME        0000  STARTING TIME
                           NQ         120  NUMBER OF HYDROGRAPH ORDINATES
                       NDDATE     21NOV98  ENDING DATE
                       NDTIME        0545  ENDING TIME
                       ICENT          19  CENTURY MARK

                  COMPUTATION INTERVAL     .25 HOURS
                       TOTAL TIME BASE   29.75 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
```

```
              FLOW                  CUBIC FEET PER SECOND
              STORAGE VOLUME        ACRE-FEET
              SURFACE AREA          ACRES
              TEMPERATURE           DEGREES FAHRENHEIT


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
   5 KK       *      SOUT  *     HEAST BASIN TO LA AVENIDA OUTFALL
              *            *
              **************
                                STORM DRAIN HYDROGRAPH

              SUBBASIN RUNOFF DATA

   7 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .09  SUBBASIN AREA

                 PRECIPITATION DATA

   8 PB                STORM        4.22  BASIN TOTAL PRECIPITATION

   9 PI            INCREMENTAL PRECIPITATION PATTERN
                       .32       .28       .20       .38       .43       .48       .48       .50       .43       .48
                       .41       .45       .60       .61       .65       .69       .84       .76       .90       .91
                       .74       .65       .73       .71       .68       .61       .66       .58       .83       .66
                       .77       .77       .77       .76       .75       .76       .58       .74       .73       .60
                       .75       .66       .69       .55       .76       .69       .72       .74       .73       .63
                       .76      1.18      1.28      1.33      1.56      1.77       .86       .96      1.09      1.49
                      1.67      1.67      1.81      2.07      2.00      1.45      2.15      2.55      2.41      4.10
                     12.29      2.41      1.50      1.16      1.14       .86       .86       .89       .94       .72
                       .75       .72       .66       .86       .42       .84       .69       .86       .69       .69
                       .71       .69       .58       .64       .76       .71

  20 LS          SCS LOSS RATE
                       STRTL         .25  INITIAL ABSTRACTION
                      CRVNBR       89.00  CURVE NUMBER
                       RTIMP       84.00  PERCENT IMPERVIOUS AREA

  19 UC          CLARK UNITGRAPH
                          TC         .35  TIME OF CONCENTRATION
                           R         .04  STORAGE COEFFICIENT

                 SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                                  ***
R INCREASED TO MINIMUM OF 0.5

                                                   UNIT HYDROGRAPH PARAMETERS
                                            CLARK   TC=   .35 HR,       R=   .13 HR
                                           SNYDER   TP=   .23 HR,      CP=   .57

                                                      UNIT HYDROGRAPH
                                                 3 END-OF-PERIOD ORDINATES
               87.      111.       24.
*****************************************************************************************************************************************

                                                HYDROGRAPH AT STATION     SOUT

*****************************************************************************************************************************************
                                                                  *
       DA MON HRMN  ORD    RAIN    LOSS  EXCESS     COMP Q       *       DA MON HRMN  ORD    RAIN    LOSS  EXCESS     COMP Q
                                                                  *
       20 NOV 0000    1     .00     .00     .00         0.       *       20 NOV 1500   61     .06     .00     .06        11.
       20 NOV 0015    2     .01     .00     .01         1.       *       20 NOV 1515   62     .07     .00     .07        14.
       20 NOV 0030    3     .01     .00     .01         2.       *       20 NOV 1530   63     .07     .00     .07        15.
       20 NOV 0045    4     .01     .00     .01         2.       *       20 NOV 1545   64     .08     .00     .07        16.
       20 NOV 0100    5     .02     .00     .01         2.       *       20 NOV 1600   65     .09     .00     .09        17.
       20 NOV 0115    6     .02     .00     .02         3.       *       20 NOV 1615   66     .08     .00     .08        18.
       20 NOV 0130    7     .02     .00     .02         3.       *       20 NOV 1630   67     .06     .00     .06        16.
       20 NOV 0145    8     .02     .00     .02         4.       *       20 NOV 1645   68     .09     .00     .09        16.
       20 NOV 0200    9     .02     .00     .02         4.       *       20 NOV 1700   69     .11     .00     .11        20.
       20 NOV 0215   10     .02     .00     .02         4.       *       20 NOV 1715   70     .10     .00     .10        23.
       20 NOV 0230   11     .02     .00     .02         4.       *       20 NOV 1730   71     .17     .00     .17        28.
       20 NOV 0245   12     .02     .00     .01         4.       *       20 NOV 1745   72     .52     .01     .51        66.
       20 NOV 0300   13     .02     .00     .02         3.       *       20 NOV 1800   73     .10     .00     .10        70.
       20 NOV 0315   14     .03     .00     .02         4.       *       20 NOV 1815   74     .06     .00     .06        29.
       20 NOV 0330   15     .03     .00     .02         5.       *       20 NOV 1830   75     .05     .00     .05        14.
       20 NOV 0345   16     .03     .00     .02         5.       *       20 NOV 1845   76     .05     .00     .05        11.
       20 NOV 0400   17     .03     .00     .02         5.       *       20 NOV 1900   77     .04     .00     .04        10.
       20 NOV 0415   18     .04     .00     .03         6.       *       20 NOV 1915   78     .04     .00     .04         8.
       20 NOV 0430   19     .03     .00     .03         6.       *       20 NOV 1930   79     .04     .00     .04         8.
       20 NOV 0445   20     .04     .00     .03         7.       *       20 NOV 1945   80     .04     .00     .04         8.
       20 NOV 0500   21     .04     .00     .03         7.       *       20 NOV 2000   81     .03     .00     .03         8.
       20 NOV 0515   22     .03     .00     .03         7.       *       20 NOV 2015   82     .03     .00     .03         7.
       20 NOV 0530   23     .03     .00     .02         6.       *       20 NOV 2030   83     .03     .00     .03         7.
       20 NOV 0545   24     .03     .00     .03         6.       *       20 NOV 2045   84     .03     .00     .03         6.
       20 NOV 0600   25     .03     .00     .03         6.       *       20 NOV 2100   85     .04     .00     .04         7.
       20 NOV 0615   26     .03     .00     .03         6.       *       20 NOV 2115   86     .02     .00     .02         6.
       20 NOV 0630   27     .03     .00     .02         6.       *       20 NOV 2130   87     .04     .00     .04         6.
       20 NOV 0645   28     .03     .00     .03         5.       *       20 NOV 2145   88     .03     .00     .03         7.
       20 NOV 0700   29     .02     .00     .02         5.       *       20 NOV 2200   89     .04     .00     .04         7.
       20 NOV 0715   30     .04     .00     .03         6.       *       20 NOV 2215   90     .03     .00     .03         7.
       20 NOV 0730   31     .03     .00     .03         6.       *       20 NOV 2230   91     .03     .00     .03         7.
       20 NOV 0745   32     .03     .00     .03         6.       *       20 NOV 2245   92     .03     .00     .03         6.
```

20 NOV 0800	33	.03	.00	.03	7.	*	20 NOV 2300	93	.03	.00	.03	6.
20 NOV 0815	34	.03	.00	.03	7.	*	20 NOV 2315	94	.02	.00	.02	6.
20 NOV 0830	35	.03	.00	.03	7.	*	20 NOV 2330	95	.03	.00	.03	6.
20 NOV 0845	36	.03	.00	.03	7.	*	20 NOV 2345	96	.03	.00	.03	6.
20 NOV 0900	37	.03	.00	.03	7.	*	21 NOV 0000	97	.03	.00	.03	7.
20 NOV 0915	38	.02	.00	.02	6.	*	21 NOV 0015	98	.00	.00	.00	4.
20 NOV 0930	39	.03	.00	.03	6.	*	21 NOV 0030	99	.00	.00	.00	1.
20 NOV 0945	40	.03	.00	.03	6.	*	21 NOV 0045	100	.00	.00	.00	0.
20 NOV 1000	41	.03	.00	.02	6.	*	21 NOV 0100	101	.00	.00	.00	0.
20 NOV 1015	42	.03	.00	.03	6.	*	21 NOV 0115	102	.00	.00	.00	0.
20 NOV 1030	43	.03	.00	.03	6.	*	21 NOV 0130	103	.00	.00	.00	0.
20 NOV 1045	44	.03	.00	.03	6.	*	21 NOV 0145	104	.00	.00	.00	0.
20 NOV 1100	45	.02	.00	.02	6.	*	21 NOV 0200	105	.00	.00	.00	0.
20 NOV 1115	46	.03	.00	.03	6.	*	21 NOV 0215	106	.00	.00	.00	0.
20 NOV 1130	47	.03	.00	.03	6.	*	21 NOV 0230	107	.00	.00	.00	0.
20 NOV 1145	48	.03	.00	.03	6.	*	21 NOV 0245	108	.00	.00	.00	0.
20 NOV 1200	49	.03	.00	.03	6.	*	21 NOV 0300	109	.00	.00	.00	0.
20 NOV 1215	50	.03	.00	.03	7.	*	21 NOV 0315	110	.00	.00	.00	0.
20 NOV 1230	51	.03	.00	.03	6.	*	21 NOV 0330	111	.00	.00	.00	0.
20 NOV 1245	52	.03	.00	.03	6.	*	21 NOV 0345	112	.00	.00	.00	0.
20 NOV 1300	53	.05	.00	.05	8.	*	21 NOV 0400	113	.00	.00	.00	0.
20 NOV 1315	54	.05	.00	.05	11.	*	21 NOV 0415	114	.00	.00	.00	0.
20 NOV 1330	55	.06	.00	.05	12.	*	21 NOV 0430	115	.00	.00	.00	0.
20 NOV 1345	56	.07	.00	.06	13.	*	21 NOV 0445	116	.00	.00	.00	0.
20 NOV 1400	57	.07	.00	.07	15.	*	21 NOV 0500	117	.00	.00	.00	0.
20 NOV 1415	58	.04	.00	.04	13.	*	21 NOV 0515	118	.00	.00	.00	0.
20 NOV 1430	59	.04	.00	.04	9.	*	21 NOV 0530	119	.00	.00	.00	0.
20 NOV 1445	60	.05	.00	.04	9.	*	21 NOV 0545	120	.00	.00	.00	0.
						*						

****

TOTAL RAINFALL = 4.22, TOTAL LOSS = .19, TOTAL EXCESS = 4.03

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	29.75-HR
70.	18.00	(CFS)	20.	9.	8.	8.
		(INCHES)	2.131	4.019	4.030	4.030
		(AC-FT)	10.	18.	18.	18.

CUMULATIVE AREA = .09 SQ MI

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	SOUT	70.	18.00	20.	9.	8.	.09		

*** NORMAL END OF HEC-1 ***

Spreadsheet C.2 La Avenida Street Outfall Energy Grade Calculations

					697' 48" RCP	48	inch		Ground El	Invert		
					15' 78" CMP	700	feet		25	13.5		
			Stevens Creek			0.015	n					
Ordinate	Time (hr)	Basin Inflow (cfs)	Discharge (cfs)	EGL (NAVD 88)	Flow thru Outfall (cfs)	Exit Loss (feet)	Friction Loss (feet)	Entrance Loss (feet)	Inlet EGL (NAVD88)	Normal Depth El (NAVD88)	Interior EGL (NAVD88)	Flapgate Status
1	0.25	1	0	11.54	1	0.00	0.00	0.00	11.54	0.00	13.50	Closed
2	0.50	2	9	11.48	2	0.00	0.00	0.00	11.49	0.31	13.81	Open
3	0.75	2	17	11.47	2	0.00	0.00	0.00	11.47	0.43	13.93	Open
4	1.00	2	57	11.49	2	0.00	0.00	0.00	11.50	0.52	14.02	Open
5	1.25	3	106	11.72	3	0.00	0.00	0.00	11.72	0.52	14.02	Open
6	1.50	3	156	12.07	3	0.00	0.00	0.00	12.08	0.60	14.10	Open
7	1.75	4	208	12.39	4	0.00	0.01	0.00	12.40	0.60	14.10	Open
8	2.00	4	285	12.77	4	0.00	0.01	0.00	12.79	0.60	14.10	Open
9	2.25	4	355	13.25	4	0.00	0.01	0.00	13.26	0.52	14.02	Open
10	2.50	4	432	13.69	4	0.00	0.01	0.00	13.70	0.60	14.10	Open
11	2.75	4	515	14.07	4	0.00	0.01	0.00	14.09	0.60	14.10	Open
12	3.00	3	603	14.46	3	0.00	0.00	0.00	14.46	0.52	14.46	Open
13	3.25	4	689	14.79	4	0.00	0.01	0.00	14.81	0.52	14.81	Open
14	3.50	5	768	15.10	5	0.00	0.01	0.00	15.12	0.60	15.12	Open
15	3.75	5	849	15.38	5	0.00	0.01	0.00	15.40	0.73	15.40	Open
16	4.00	5	932	15.65	5	0.00	0.01	0.00	15.67	0.67	15.67	Open
17	4.25	6	1016	15.91	6	0.01	0.02	0.00	15.93	0.67	15.93	Open
18	4.50	6	1103	16.16	6	0.01	0.02	0.00	16.18	0.67	16.18	Open
19	4.75	7	1225	16.44	7	0.01	0.02	0.00	16.47	0.79	16.47	Open
20	5.00	7	1411	16.84	7	0.01	0.02	0.00	16.87	0.79	16.87	Open
21	5.25	7	1599	17.27	7	0.01	0.02	0.00	17.30	0.79	17.30	Open
22	5.50	6	1787	17.70	6	0.01	0.02	0.00	17.72	0.73	17.72	Open
23	5.75	6	1959	18.09	6	0.01	0.02	0.00	18.11	0.73	18.11	Open
24	6.00	6	2101	18.42	6	0.01	0.02	0.00	18.44	0.67	18.44	Open
25	6.25	6	2217	18.69	6	0.01	0.02	0.00	18.71	0.73	18.71	Open
26	6.50	6	2302	18.89	6	0.01	0.02	0.00	18.91	0.73	18.91	Open
27	6.75	5	2346	19.02	5	0.00	0.01	0.00	19.04	0.67	19.04	Open
28	7.00	5	2358	19.09	5	0.00	0.01	0.00	19.11	0.67	19.11	Open
29	7.25	6	2351	19.10	6	0.01	0.02	0.00	19.12	0.73	19.12	Open
30	7.50	6	2326	19.08	6	0.01	0.02	0.00	19.10	0.79	19.10	Open
31	7.75	6	2294	19.04	6	0.01	0.02	0.00	19.06	0.79	19.06	Open
32	8.00	7	2272	18.99	7	0.01	0.02	0.00	19.02	0.79	19.02	Open
33	8.25	7	2265	18.96	7	0.01	0.02	0.00	18.99	0.73	18.99	Open
34	8.50	7	2277	18.97	7	0.01	0.02	0.00	19.00	0.79	19.00	Open
35	8.75	7	2294	18.99	7	0.01	0.02	0.00	19.02	0.79	19.02	Open
36	9.00	7	2307	19.01	7	0.01	0.02	0.00	19.04	0.73	19.04	Open
37	9.25	6	2320	19.04	6	0.01	0.02	0.00	19.06	0.73	19.06	Open
38	9.50	6	2332	19.06	6	0.01	0.02	0.00	19.08	0.73	19.08	Open
39	9.75	6	2335	19.07	6	0.01	0.02	0.00	19.09	0.73	19.09	Open
40	10.00	6	2327	19.07	6	0.01	0.02	0.00	19.09	0.73	19.09	Open
41	10.25	6	2320	19.06	6	0.01	0.02	0.00	19.08	0.73	19.08	Open
42	10.50	6	2311	19.04	6	0.01	0.02	0.00	19.06	0.73	19.06	Open
43	10.75	6	2304	19.03	6	0.01	0.02	0.00	19.05	0.73	19.05	Open
44	11.00	6	2310	19.03	6	0.01	0.02	0.00	19.05	0.73	19.05	Open
45	11.25	6	2316	19.04	6	0.01	0.02	0.00	19.06	0.73	19.06	Open
46	11.50	6	2318	19.04	6	0.01	0.02	0.00	19.06	0.73	19.06	Open
47	11.75	6	2327	19.06	6	0.01	0.02	0.00	19.08	0.73	19.08	Open
48	12.00	6	2358	19.09	6	0.01	0.02	0.00	19.11	0.79	19.11	Open
49	12.25	7	2400	19.16	7	0.01	0.02	0.00	19.19	0.79	19.19	Open
50	12.50	6	2435	19.22	6	0.01	0.02	0.00	19.24	0.84	19.24	Open
51	12.75	6	2457	19.27	6	0.01	0.02	0.00	19.29	0.84	19.29	Open
52	13.00	8	2463	19.30	8	0.01	0.03	0.00	19.34	0.84	19.34	Open
53	13.25	11	2468	19.31	11	0.01	0.05	0.01	19.38	0.73	19.38	Open
54	13.50	12	2499	19.35	12	0.01	0.06	0.01	19.43	0.79	19.43	Open
55	13.75	13	2558	19.43	13	0.01	0.08	0.01	19.52	1.03	19.52	Open
56	14.00	15	2637	19.54	15	0.01	0.10	0.01	19.66	1.12	19.66	Open
57	14.25	13	2737	19.69	13	0.01	0.08	0.01	19.78	1.12	19.78	Open
58	14.50	9	2848	19.87	9	0.01	0.04	0.00	19.92	1.03	19.92	Open
59	14.75	9	2917	20.01	9	0.01	0.04	0.00	20.06	0.89	20.06	Open
60	15.00	11	2918	20.07	11	0.01	0.05	0.01	20.14	0.94	20.14	Open
61	15.25	14	2914	20.08	14	0.01	0.09	0.01	20.19	0.94	20.19	Open
62	15.50	15	2950	20.11	15	0.01	0.10	0.01	20.23	1.16	20.23	Open
63	15.75	16	3013	20.19	16	0.02	0.12	0.01	20.33	1.31	20.33	Open
64	16.00	17	3076	20.28	17	0.02	0.13	0.01	20.43	1.24	20.43	Open

					697' 48" RCP	48	inch		Ground El	Invert		
					15' 78" CMP	700	feet		25	13.5		
			Stevens Creek			0.015	n					
Ordinate	Time (hr)	Basin Inflow (cfs)	Discharge (cfs)	EGL (NAVD 88)	Flow thru Outfall (cfs)	Exit Loss (feet)	Friction Loss (feet)	Entrance Loss (feet)	Inlet EGL (NAVD88)	Normal Depth El (NAVD88)	Interior EGL (NAVD88)	Flapgate Status
65	16.25	18	3144	20.38	18	0.02	0.15	0.01	20.55	1.12	20.55	Open
66	16.50	16	3241	20.51	16	0.02	0.12	0.01	20.65	1.16	20.65	Open
67	16.75	16	3346	20.66	16	0.02	0.12	0.01	20.80	1.34	20.80	Open
68	17.00	20	3415	20.78	20	0.02	0.18	0.01	20.99	1.41	20.99	Open
69	17.25	23	3459	20.87	23	0.02	0.24	0.01	21.14	1.24	21.14	Open
70	17.50	28	3527	20.96	28	0.03	0.35	0.01	21.35	1.79	21.35	Open
71	17.75	66	3716	21.16	66	0.06	1.96	0.03	23.21	2.20	23.21	Open
72	18.00	70	3797	21.32	70	0.07	2.20	0.03	23.62	1.91	23.62	Open
73	18.25	29	3972	21.51	29	0.03	0.38	0.01	21.93	2.20	21.93	Open
74	18.50	14	4262	21.83	14	0.01	0.09	0.01	21.94	1.91	21.94	Open
75	18.75	11	4643	22.26	11	0.01	0.05	0.01	22.33	1.12	22.33	Open
76	19.00	10	5025	22.72	10	0.01	0.04	0.00	22.78	0.99	22.78	Open
77	19.25	8	5378	23.16	8	0.01	0.03	0.00	23.20	0.99	23.20	Open
78	19.50	8	5654	23.50	8	0.01	0.03	0.00	23.54	1.08	23.54	Open
79	19.75	8	5753	23.69	8	0.01	0.03	0.00	23.73	1.03	23.73	Open
80	20.00	8	5722	23.73	8	0.01	0.03	0.00	23.77	0.79	23.77	Open
81	20.25	7	5689	23.71	7	0.01	0.02	0.00	23.74	0.79	23.74	Open
82	20.50	7	5663	23.68	7	0.01	0.02	0.00	23.71	0.84	23.71	Open
83	20.75	6	5636	23.65	6	0.01	0.02	0.00	23.68	0.79	23.68	Open
84	21.00	7	5614	23.63	7	0.01	0.02	0.00	23.66	0.73	23.66	Open
85	21.25	6	5600	23.61	6	0.01	0.02	0.00	23.64	0.79	23.64	Open
86	21.50	6	5591	23.60	6	0.01	0.02	0.00	23.63	0.79	23.63	Open
87	21.75	7	5579	23.58	7	0.01	0.02	0.00	23.61	0.84	23.61	Open
88	22.00	7	5564	23.57	7	0.01	0.02	0.00	23.60	0.84	23.60	Open
89	22.25	7	5568	23.57	7	0.01	0.02	0.00	23.60	0.73	23.60	Open
90	22.50	7	5576	23.57	7	0.01	0.02	0.00	23.60	0.79	23.60	Open
91	22.75	6	5579	23.58	6	0.01	0.02	0.00	23.61	0.79	23.61	Open
92	23.00	6	5576	23.58	6	0.01	0.02	0.00	23.61	0.67	23.61	Open
93	23.25	6	5571	23.57	6	0.01	0.02	0.00	23.60	0.67	23.60	Open
94	23.50	6	5570	23.57	6	0.01	0.02	0.00	23.60	0.67	23.60	Open
95	23.75	6	5565	23.56	6	0.01	0.02	0.00	23.59	0.73	23.59	Open
96	24.00	7	5557	23.56	7	0.01	0.02	0.00	23.59	0.73	23.59	Open
97	24.25	4	5557	23.55	4	0.00	0.01	0.00	23.56	0.84	23.56	Open
98	24.50	1	5511	23.52	1	0.00	0.00	0.00	23.52	0.60	23.52	Open
99	24.75	0	5308	23.37	0	0.00	0.00	0.00	23.37	0.00	23.37	Closed
100	25.00		4973	23.06	0	0.00	0.00	0.00	23.06	0.00	23.06	Closed
101	25.25		4619	22.67	0	0.00	0.00	0.00	22.67	0.00	22.67	Closed
102	25.50		4286	22.26	0	0.00	0.00	0.00	22.26	0.00	22.26	Closed
103	25.75		3983	21.86	0	0.00	0.00	0.00	21.86	0.00	21.86	Closed
104	26.00		3718	21.48	0	0.00	0.00	0.00	21.48	0.00	21.48	Closed
105	26.25		3476	21.14	0	0.00	0.00	0.00	21.14	0.00	21.14	Closed
106	26.50		3269	20.82	0	0.00	0.00	0.00	20.82	0.00	20.82	Closed
107	26.75		3086	20.53	0	0.00	0.00	0.00	20.53	0.00	20.53	Closed
108	27.00		2918	20.26	0	0.00	0.00	0.00	20.26	0.00	20.26	Closed
109	27.25		2763	19.99	0	0.00	0.00	0.00	19.99	0.00	19.99	Closed
110	27.50		2612	19.74	0	0.00	0.00	0.00	19.74	0.00	19.74	Closed
111	27.75		2466	19.48	0	0.00	0.00	0.00	19.48	0.00	19.48	Closed
112	28.00		2315	19.22	0	0.00	0.00	0.00	19.22	0.00	19.22	Closed
113	28.25		2163	18.94	0	0.00	0.00	0.00	18.94	0.00	18.94	Closed
114	28.50		2015	18.65	0	0.00	0.00	0.00	18.65	0.00	18.65	Closed
115	28.75		1870	18.36	0	0.00	0.00	0.00	18.36	0.00	18.36	Closed
116	29.00		1728	18.06	0	0.00	0.00	0.00	18.06	0.00	18.06	Closed
117	29.25		1591	17.77	0	0.00	0.00	0.00	17.77	0.00	17.77	Closed
118	29.50		1460	17.46	0	0.00	0.00	0.00	17.46	0.00	17.46	Closed
119	29.75		1336	17.17	0	0.00	0.00	0.00	17.17	0.00	17.17	Closed
120	30.00		1220	16.87	0	0.00	0.00	0.00	16.87	0.00	16.87	Closed
121	30.25		1114	16.59	0	0.00	0.00	0.00	16.59	0.00	16.59	Closed
122	30.50		1028	16.33	0	0.00	0.00	0.00	16.33	0.00	16.33	Closed
123	30.75		977	16.13	0	0.00	0.00	0.00	16.13	0.00	16.13	Closed
124	31.00		931	15.98	0	0.00	0.00	0.00	15.98	0.00	15.98	Closed
125	31.25		874	15.82	0	0.00	0.00	0.00	15.82	0.00	15.82	Closed
126	31.50		811	15.64	0	0.00	0.00	0.00	15.64	0.00	15.64	Closed
127	31.75		749	15.45	0	0.00	0.00	0.00	15.45	0.00	15.45	Closed
128	32.00		690	15.26	0	0.00	0.00	0.00	15.26	0.00	15.26	Closed
129	32.25		635	15.07	0	0.00	0.00	0.00	15.07	0.00	15.07	Closed

					697' 48" RCP	48	inch		Ground El	Invert		
					15' 78" CMP	700	feet		25	13.5		
			Stevens Creek			0.015	n					
Ordinate	Time (hr)	Basin Inflow (cfs)	Discharge (cfs)	EGL (NAVD 88)	Flow thru Outfall (cfs)	Exit Loss (feet)	Friction Loss (feet)	Entrance Loss (feet)	Inlet EGL (NAVD88)	Normal Depth El (NAVD88)	Interior EGL (NAVD88)	Flapgate Status
130	32.50		585	14.88	0	0.00	0.00	0.00	14.88	0.00	14.88	Closed
131	32.75		541	14.70	0	0.00	0.00	0.00	14.70	0.00	14.70	Closed
132	33.00		503	14.54	0	0.00	0.00	0.00	14.54	0.00	14.54	Closed
133	33.25		472	14.39	0	0.00	0.00	0.00	14.39	0.00	14.39	Closed
134	33.50		446	14.26	0	0.00	0.00	0.00	14.26	0.00	14.26	Closed
135	33.75		425	14.15	0	0.00	0.00	0.00	14.15	0.00	14.15	Closed
136	34.00		409	14.05	0	0.00	0.00	0.00	14.05	0.00	14.05	Closed
137	34.25		398	13.97	0	0.00	0.00	0.00	13.97	0.00	13.97	Closed
138	34.50		389	13.91	0	0.00	0.00	0.00	13.91	0.00	13.91	Closed
139	34.75		382	13.86	0	0.00	0.00	0.00	13.86	0.00	13.86	Closed
140	35.00		378	13.82	0	0.00	0.00	0.00	13.82	0.00	13.82	Closed
141	35.25		374	13.79	0	0.00	0.00	0.00	13.79	0.00	13.79	Closed
142	35.50		372	13.77	0	0.00	0.00	0.00	13.77	0.00	13.77	Closed
143	35.75		371	13.76	0	0.00	0.00	0.00	13.76	0.00	13.76	Closed
144	36.00		370	13.75	0	0.00	0.00	0.00	13.75	0.00	13.75	Closed
145	36.25		369	13.75	0	0.00	0.00	0.00	13.75	0.00	13.75	Closed
146	36.50		369	13.74	0	0.00	0.00	0.00	13.74	0.00	13.74	Closed
147	36.75		368	13.74	0	0.00	0.00	0.00	13.74	0.00	13.74	Closed
148	37.00		368	13.74	0	0.00	0.00	0.00	13.74	0.00	13.74	Closed
149	37.25		368	13.73	0	0.00	0.00	0.00	13.73	0.00	13.73	Closed
150	37.50		368	13.73	0	0.00	0.00	0.00	13.73	0.00	13.73	Closed
151	37.75		368	13.73	0	0.00	0.00	0.00	13.73	0.00	13.73	Closed
152	38.00		368	13.73	0	0.00	0.00	0.00	13.73	0.00	13.73	Closed
153	38.25		368	13.73	0	0.00	0.00	0.00	13.73	0.00	13.73	Closed
154	38.50		367	13.72	0	0.00	0.00	0.00	13.72	0.00	13.72	Closed
155	38.75		365	13.71	0	0.00	0.00	0.00	13.71	0.00	13.71	Closed
156	39.00		361	13.69	0	0.00	0.00	0.00	13.69	0.00	13.69	Closed
157	39.25		357	13.67	0	0.00	0.00	0.00	13.67	0.00	13.67	Closed
158	39.50		352	13.64	0	0.00	0.00	0.00	13.64	0.00	13.64	Closed
159	39.75		346	13.61	0	0.00	0.00	0.00	13.61	0.00	13.61	Closed
160	40.00		340	13.58	0	0.00	0.00	0.00	13.58	0.00	13.58	Closed
161	40.25		334	13.55	0	0.00	0.00	0.00	13.55	0.00	13.55	Closed
162	40.50		328	13.51	0	0.00	0.00	0.00	13.51	0.00	13.51	Closed
163	40.75		321	13.48	0	0.00	0.00	0.00	13.48	0.00	13.50	Closed
164	41.00		315	13.44	0	0.00	0.00	0.00	13.44	0.00	13.50	Closed
165	41.25		309	13.41	0	0.00	0.00	0.00	13.41	0.00	13.50	Closed
166	41.50		302	13.37	0	0.00	0.00	0.00	13.37	0.00	13.50	Closed
167	41.75		296	13.33	0	0.00	0.00	0.00	13.33	0.00	13.50	Closed
168	42.00		291	13.29	0	0.00	0.00	0.00	13.29	0.00	13.50	Closed
169	42.25		285	13.25	0	0.00	0.00	0.00	13.25	0.00	13.50	Closed
170	42.50		279	13.21	0	0.00	0.00	0.00	13.21	0.00	13.50	Closed
171	42.75		273	13.17	0	0.00	0.00	0.00	13.17	0.00	13.50	Closed
172	43.00		268	13.13	0	0.00	0.00	0.00	13.13	0.00	13.50	Closed
173	43.25		263	13.09	0	0.00	0.00	0.00	13.09	0.00	13.50	Closed
174	43.50		258	13.05	0	0.00	0.00	0.00	13.05	0.00	13.50	Closed
175	43.75		252	13.01	0	0.00	0.00	0.00	13.01	0.00	13.50	Closed
176	44.00		247	12.97	0	0.00	0.00	0.00	12.97	0.00	13.50	Closed
177	44.25		242	12.93	0	0.00	0.00	0.00	12.93	0.00	13.50	Closed
178	44.50		237	12.89	0	0.00	0.00	0.00	12.89	0.00	13.50	Closed
179	44.75		233	12.86	0	0.00	0.00	0.00	12.86	0.00	13.50	Closed
180	45.00		228	12.82	0	0.00	0.00	0.00	12.82	0.00	13.50	Closed
181	45.25		223	12.79	0	0.00	0.00	0.00	12.79	0.00	13.50	Closed
182	45.50		219	12.76	0	0.00	0.00	0.00	12.76	0.00	13.50	Closed
183	45.75		215	12.72	0	0.00	0.00	0.00	12.72	0.00	13.50	Closed
184	46.00		210	12.69	0	0.00	0.00	0.00	12.69	0.00	13.50	Closed
185	46.25		206	12.66	0	0.00	0.00	0.00	12.66	0.00	13.50	Closed
186	46.50		202	12.62	0	0.00	0.00	0.00	12.62	0.00	13.50	Closed
187	46.75		198	12.59	0	0.00	0.00	0.00	12.59	0.00	13.50	Closed
188	47.00		194	12.55	0	0.00	0.00	0.00	12.55	0.00	13.50	Closed
189	47.25		190	12.51	0	0.00	0.00	0.00	12.51	0.00	13.50	Closed
190	47.50		186	12.49	0	0.00	0.00	0.00	12.49	0.00	13.50	Closed
191	47.75		183	12.27	0	0.00	0.00	0.00	12.27	0.00	13.50	Closed
192	48.00		181	12.26	0	0.00	0.00	0.00	12.26	0.00	13.50	Closed

Spreadsheet C.3: West Outfall to Charleston Detention Pond

Intensity (from Santa Clara County Drainage Manual)

Intensity

I = K/t^n
I = Intensity
k = 1.008
MAP = 14
Q = kCiA
100-yr K = 1.02
n = 0.52

Pipe Capacity (Mannings)

Sf = ((Q*n)/(1.49*A*R^(2/3)))^2
V = Q/A
V = Velocity, ft/s
R = hydraulic radius, ft (A/P)
A = cross-sectional flow area, sf (pipe area since assuming flowing full)
P = Wetted perimeter, ft (pipe perimeter since assuming flowing full)
Sf = Friction slope,
n = 0.013

Flow

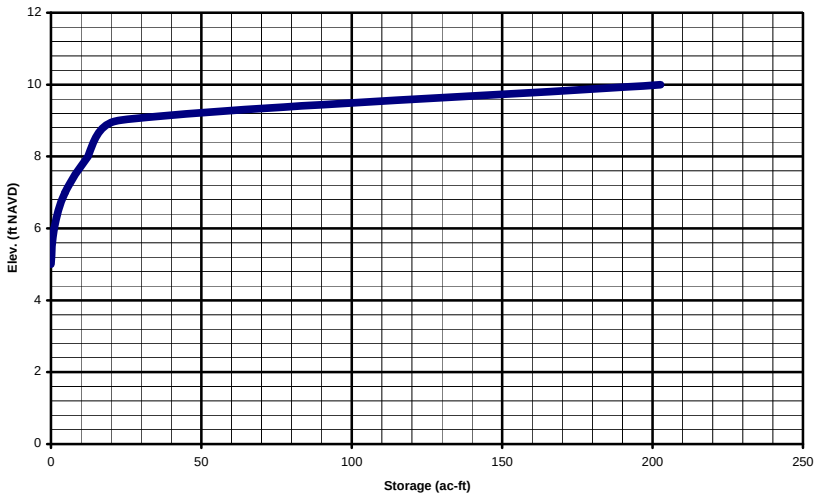
Q = kCiA
k = 1.008

ID/Name	Land Use Coeff	Time of Concentration min	DA acres	C x A acres	Cumulative C x A acres	100-yr intensity in/hr	100-yr Q cfs	Pipe Length ft	Pipe diam in	Pipe area sf	Pipe P ft	Pipe R ft	100-year Velocity fps	Ground El ft	Hydraulic Gradient ft/ft	Friction Loss ft	Minor Loss ft	Pipe Invert ft	EGL ft	Street Surcharge ft
1 1-2	0.81	17.80	9.14	7.41	7.41	1.92	14.21	506.00	24	3.14	6.28	0.50	4.52	24.0	0.00392	1.99		18.3	20.30	-3.70
2 2-3	0.69	19.66	1.67	1.15	8.56	1.82	15.59	142.00	24	3.14	6.28	0.50	4.96	26.0	0.00472	0.67		12.5	14.92	-11.08
3 3-4	0.65	20.14	1.17	0.76	9.32	1.80	16.77	252.00	33	5.94	8.64	0.69	2.82	25.5	0.00100	0.25		11.5	14.25	-11.25
4 4-5	0.71	21.63	0.97	0.69	10.01	1.73	17.35	352.00	33	5.94	8.64	0.69	2.92	23.2	0.00107	0.38		10.6	13.98	-9.22
5 5-6	0.77	23.64	22.29	17.17	27.17	1.66	44.99	312.00	48	12.57	12.57	1.00	3.58	20.0	0.00098	0.30		7.6	13.61	-6.39
6 6-7	0.81	25.09	1.99	1.61	28.78	1.61	46.20	270.00	48	12.57	12.57	1.00	3.68	18.0	0.00103	0.28		6.0	13.30	-4.70
7 7-8	0.77	26.31	9.66	7.44	36.22	1.57	56.71	458.00	54	15.90	14.14	1.13	3.57	17.2	0.00083	0.38		6.0	13.02	-4.18
8 8-9	0.75	28.45	8.86	6.64	42.86	1.50	64.44	516.00	54	15.90	14.14	1.13	4.05	15.0	0.00107	0.55		4.1	12.64	-2.36
9 9-10	0.73	30.58	1.59	1.16	44.03	1.45	63.76	263.00	54	15.90	14.14	1.13	4.01	13.4	0.00105	0.28		3.3	12.09	-1.31
10 10-11	0.73	31.67	88.53	64.63	108.66	1.42	154.51	416.00	60	19.63	15.71	1.25	7.87	13.0	0.00350	1.46		3.8	11.82	-1.18
11 11-out	0.65	32.55	1.16	0.76	109.41	1.40	153.38	100.00	60	19.63	15.71	1.25	7.81	12.0 11.5	0.00345	0.34	0.95	4.1	10.36 9.07	-1.64
			147.04																	

Check tc for Basin 10 = 10 min + 200' of pavement at 1% slope (2 fps) + 3200' of pipe at 5 fps = 22 minutes; does not control.

Stage-Area Data for Charleston Detention Pond

Stage (ft)	Area (acres)	Volume (af)
5	1.031	0
6	1.086	1.06
7	6.157	4.68
8	9.17	12.34
9	10.78	22.32
10	350	202.71



HYDROGRAPH ROUTING THROUGH CHARLESTON DETENTION POND

```
1****************************************                                                    ****************************************
 *                                      *                                                    *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                                    *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998              *                                                    *    HYDROLOGIC ENGINEERING CENTER     *
 *            VERSION 4.1               *                                                    *          609 SECOND STREET           *
 *                                      *                                                    *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   09JAN09  TIME  16:27:57  *                                                    *           (916) 756-1104             *
 *                                      *                                                    *                                      *
 ****************************************                                                    ****************************************


                                                X     X  XXXXXXX   XXXXX           X
                                                X     X  X        X     X         XX
                                                X     X  X        X               X
                                                XXXXXXX  XXXX     X        XXXXX   X
                                                X     X  X        X                X
                                                X     X  X        X     X          X
                                                X     X  XXXXXXX   XXXXX         XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                                   HEC-1 INPUT                                                   PAGE  1

         LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1          ID   Stevens Creek Hydrograph Routing - Charleston Pump Station
            2          ID   Emily Caldwell, Schaaf & Wheeler, November 19, 2008
            3          IT      15 20NOV98       0     120
            4          IO       1
                       *

            5          KK    WEST BASIN TO CHARLESTON PS
            6          KM    STORM DRAIN HYDROGRAPH WEST
            7          BA     .23
            8          PB    4.22
            9          PI    0.32    0.28    0.20    0.38    0.43    0.48    0.48    0.50    0.43    0.48
           10          PI    0.41    0.45    0.60    0.61    0.65    0.69    0.84    0.76    0.90    0.91
           11          PI    0.74    0.65    0.73    0.71    0.68    0.61    0.66    0.58    0.83    0.66
           12          PI    0.77    0.77    0.77    0.76    0.75    0.76    0.58    0.74    0.73    0.60
           13          PI    0.75    0.66    0.69    0.55    0.76    0.69    0.72    0.74    0.73    0.63
           14          PI    0.76    1.18    1.28    1.33    1.56    1.77    0.86    0.96    1.09    1.49
           15          PI    1.67    1.67    1.81    2.07    2.00    1.45    2.15    2.55    2.41    4.10
           16          PI   12.29    2.41    1.50    1.16    1.14    0.86    0.86    0.89    0.94    0.72
           17          PI    0.75    0.72    0.66    0.86    0.42    0.84    0.69    0.86    0.69    0.69
           18          PI    0.71    0.69    0.58    0.64    0.76    0.71
                       *
           19          UC     .63     .42
           20          LS       0      89      68
                       *

           21          KK    DIRECT DRAINAGE TO CHARLESTON PS
           22          KM    STORM DRAIN HYDROGRAPH DIRECT
           23          BA    .301
                       *
           24          UC    0.87     .22
           25          LS       0      89      80
                       *

           26          KK    INFLOW
           27          HC       2
                       *

           28          KK    POND
           29          KM    DETENTION POND AND PUMP STATION (ENGINE DRIVEN PUMPS ONLY)
           30          RS       1    ELEV     5.0       0
           31          SA   1.031   1.086   6.157   9.170   10.78     350
           32          SE       5       6       7       8       9      10
           33          SS       9     215     2.5     1.5
           34          WP     5.1   38.54       1
           35          WP     5.6   38.54     5.2
                       *
           36          ZZ
```

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1****************************************                                                    ****************************************
 *                                      *                                                    *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                                    *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998              *                                                    *    HYDROLOGIC ENGINEERING CENTER     *
 *            VERSION 4.1               *                                                    *          609 SECOND STREET           *
 *                                      *                                                    *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   09JAN09  TIME  16:27:57  *                                                    *           (916) 756-1104             *
 *                                      *                                                    *                                      *
 ****************************************                                                    ****************************************


                          Stevens Creek Hydrograph Routing - Charleston Pump Station
                          Emily Caldwell, Schaaf & Wheeler, November 19, 2008

   4 IO          OUTPUT CONTROL VARIABLES
                       IPRNT           1  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                        NMIN          15  MINUTES IN COMPUTATION INTERVAL
                       IDATE     20NOV98  STARTING DATE
                       ITIME        0000  STARTING TIME
                          NQ         120  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE     21NOV98  ENDING DATE
                      NDTIME        0545  ENDING TIME
                       ICENT          19  CENTURY MARK

                  COMPUTATION INTERVAL     .25 HOURS
                       TOTAL TIME BASE   29.75 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   5 KK     *      WEST  *      BASIN TO CHARLESTON PS
            *            *
            **************
                            STORM DRAIN HYDROGRAPH WEST

               SUBBASIN RUNOFF DATA

   7 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .23  SUBBASIN AREA

                 PRECIPITATION DATA

   8 PB                STORM        4.22  BASIN TOTAL PRECIPITATION

   9 PI            INCREMENTAL PRECIPITATION PATTERN
                       .32       .28       .20       .38       .43       .48       .48       .50       .43       .48
                       .41       .45       .60       .61       .65       .69       .84       .76       .90       .91
                       .74       .65       .73       .71       .68       .61       .66       .58       .83       .66
                       .77       .77       .77       .76       .75       .76       .58       .74       .73       .60
                       .75       .66       .69       .55       .76       .69       .72       .74       .73       .63
                       .76      1.18      1.28      1.33      1.56      1.77       .86       .96      1.09      1.49
                      1.67      1.67      1.81      2.07      2.00      1.45      2.15      2.55      2.41      4.10
                     12.29      2.41      1.50      1.16      1.14       .86       .86       .89       .94       .72
                       .75       .72       .66       .86       .42       .84       .69       .86       .69       .69
                       .71       .69       .58       .64       .76       .71

  20 LS          SCS LOSS RATE
                       STRTL         .25  INITIAL ABSTRACTION
                      CRVNBR       89.00  CURVE NUMBER
                       RTIMP       68.00  PERCENT IMPERVIOUS AREA

  19 UC          CLARK UNITGRAPH
                          TC         .63  TIME OF CONCENTRATION
                           R         .42  STORAGE COEFFICIENT

                 SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                          ***

                                                UNIT HYDROGRAPH PARAMETERS
                                          CLARK   TC=   .63 HR,       R=   .42 HR
                                         SNYDER   TP=   .51 HR,      CP=   .61

                                                   UNIT HYDROGRAPH
                                              11 END-OF-PERIOD ORDINATES
               48.      144.      166.      108.       58.       32.       17.        9.        5.        3.
                1.

*****************************************************************************************************************************
```

HYDROGRAPH AT STATION WEST

DA MON HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q	DA MON HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q
20 NOV 0000	1	.00	.00	.00	0.	20 NOV 1500	61	.06	.00	.06	27.
20 NOV 0015	2	.01	.00	.01	0.	20 NOV 1515	62	.07	.00	.07	29.
20 NOV 0030	3	.01	.00	.01	2.	20 NOV 1530	63	.07	.00	.07	33.
20 NOV 0045	4	.01	.00	.01	3.	20 NOV 1545	64	.08	.00	.07	36.
20 NOV 0100	5	.02	.01	.01	4.	20 NOV 1600	65	.09	.00	.08	39.
20 NOV 0115	6	.02	.01	.01	5.	20 NOV 1615	66	.08	.00	.08	42.
20 NOV 0130	7	.02	.01	.01	6.	20 NOV 1630	67	.06	.00	.06	44.
20 NOV 0145	8	.02	.01	.01	7.	20 NOV 1645	68	.09	.00	.09	43.
20 NOV 0200	9	.02	.01	.01	7.	20 NOV 1700	69	.11	.00	.10	45.
20 NOV 0215	10	.02	.01	.01	8.	20 NOV 1715	70	.10	.00	.10	50.
20 NOV 0230	11	.02	.01	.01	8.	20 NOV 1730	71	.17	.01	.17	57.
20 NOV 0245	12	.02	.01	.01	8.	20 NOV 1745	72	.52	.02	.50	85.
20 NOV 0300	13	.02	.01	.01	8.	20 NOV 1800	73	.10	.00	.10	127.
20 NOV 0315	14	.03	.01	.02	8.	20 NOV 1815	74	.06	.00	.06	131.
20 NOV 0330	15	.03	.01	.02	8.	20 NOV 1830	75	.05	.00	.05	98.
20 NOV 0345	16	.03	.01	.02	9.	20 NOV 1845	76	.05	.00	.05	68.
20 NOV 0400	17	.03	.01	.02	10.	20 NOV 1900	77	.04	.00	.04	49.
20 NOV 0415	18	.04	.01	.03	11.	20 NOV 1915	78	.04	.00	.04	38.
20 NOV 0430	19	.03	.01	.02	12.	20 NOV 1930	79	.04	.00	.04	30.
20 NOV 0445	20	.04	.01	.03	13.	20 NOV 1945	80	.04	.00	.04	26.
20 NOV 0500	21	.04	.01	.03	15.	20 NOV 2000	81	.03	.00	.03	24.
20 NOV 0515	22	.03	.01	.02	15.	20 NOV 2015	82	.03	.00	.03	22.
20 NOV 0530	23	.03	.01	.02	15.	20 NOV 2030	83	.03	.00	.03	20.
20 NOV 0545	24	.03	.01	.02	15.	20 NOV 2045	84	.03	.00	.03	19.
20 NOV 0600	25	.03	.01	.02	14.	20 NOV 2100	85	.04	.00	.04	18.
20 NOV 0615	26	.03	.01	.02	14.	20 NOV 2115	86	.02	.00	.02	18.
20 NOV 0630	27	.03	.00	.02	14.	20 NOV 2130	87	.04	.00	.03	17.
20 NOV 0645	28	.03	.01	.02	14.	20 NOV 2145	88	.03	.00	.03	17.
20 NOV 0700	29	.02	.00	.02	13.	20 NOV 2200	89	.04	.00	.04	18.
20 NOV 0715	30	.04	.01	.03	13.	20 NOV 2215	90	.03	.00	.03	18.
20 NOV 0730	31	.03	.00	.02	14.	20 NOV 2230	91	.03	.00	.03	18.
20 NOV 0745	32	.03	.01	.03	14.	20 NOV 2245	92	.03	.00	.03	18.
20 NOV 0800	33	.03	.01	.03	15.	20 NOV 2300	93	.03	.00	.03	17.
20 NOV 0815	34	.03	.00	.03	15.	20 NOV 2315	94	.02	.00	.02	17.
20 NOV 0830	35	.03	.00	.03	16.	20 NOV 2330	95	.03	.00	.03	16.
20 NOV 0845	36	.03	.00	.03	16.	20 NOV 2345	96	.03	.00	.03	16.
20 NOV 0900	37	.03	.00	.03	16.	21 NOV 0000	97	.03	.00	.03	17.
20 NOV 0915	38	.02	.00	.02	16.	21 NOV 0015	98	.00	.00	.00	16.
20 NOV 0930	39	.03	.00	.03	15.	21 NOV 0030	99	.00	.00	.00	12.
20 NOV 0945	40	.03	.00	.03	15.	21 NOV 0045	100	.00	.00	.00	7.
20 NOV 1000	41	.03	.00	.02	15.	21 NOV 0100	101	.00	.00	.00	4.
20 NOV 1015	42	.03	.00	.03	15.	21 NOV 0115	102	.00	.00	.00	2.
20 NOV 1030	43	.03	.00	.02	15.	21 NOV 0130	103	.00	.00	.00	1.
20 NOV 1045	44	.03	.00	.03	15.	21 NOV 0145	104	.00	.00	.00	1.
20 NOV 1100	45	.02	.00	.02	15.	21 NOV 0200	105	.00	.00	.00	0.
20 NOV 1115	46	.03	.00	.03	15.	21 NOV 0215	106	.00	.00	.00	0.
20 NOV 1130	47	.03	.00	.03	15.	21 NOV 0230	107	.00	.00	.00	0.
20 NOV 1145	48	.03	.00	.03	15.	21 NOV 0245	108	.00	.00	.00	0.
20 NOV 1200	49	.03	.00	.03	16.	21 NOV 0300	109	.00	.00	.00	0.
20 NOV 1215	50	.03	.00	.03	16.	21 NOV 0315	110	.00	.00	.00	0.
20 NOV 1230	51	.03	.00	.02	16.	21 NOV 0330	111	.00	.00	.00	0.
20 NOV 1245	52	.03	.00	.03	16.	21 NOV 0345	112	.00	.00	.00	0.
20 NOV 1300	53	.05	.00	.05	17.	21 NOV 0400	113	.00	.00	.00	0.
20 NOV 1315	54	.05	.00	.05	20.	21 NOV 0415	114	.00	.00	.00	0.
20 NOV 1330	55	.06	.00	.05	24.	21 NOV 0430	115	.00	.00	.00	0.
20 NOV 1345	56	.07	.00	.06	27.	21 NOV 0445	116	.00	.00	.00	0.
20 NOV 1400	57	.07	.01	.07	31.	21 NOV 0500	117	.00	.00	.00	0.
20 NOV 1415	58	.04	.00	.03	33.	21 NOV 0515	118	.00	.00	.00	0.
20 NOV 1430	59	.04	.00	.04	31.	21 NOV 0530	119	.00	.00	.00	0.
20 NOV 1445	60	.05	.00	.04	27.	21 NOV 0545	120	.00	.00	.00	0.

TOTAL RAINFALL = 4.22, TOTAL LOSS = .38, TOTAL EXCESS = 3.84

	PEAK FLOW (CFS)	TIME (HR)	MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	29.75-HR
+	131.	18.25	(CFS) 51.	24.	19.	19.
			(INCHES) 2.053	3.807	3.828	3.828
			(AC-FT) 25.	47.	47.	47.

CUMULATIVE AREA = .23 SQ MI

*** ***

```
              **************
              *            *
  21 KK       *      DIRE  *     CT DRAINAGE TO CHARLESTON PS
              *            *
              **************
                             STORM DRAIN HYDROGRAPH DIRECT

                SUBBASIN RUNOFF DATA

  23 BA           SUBBASIN CHARACTERISTICS
                        TAREA         .30  SUBBASIN AREA

                  PRECIPITATION DATA
```

```
 8 PB                STORM        4.22  BASIN TOTAL PRECIPITATION

 9 PI            INCREMENTAL PRECIPITATION PATTERN
                     .32       .28       .20       .38       .43       .48       .48       .50       .43       .48
                     .41       .45       .60       .61       .65       .69       .84       .76       .90       .91
                     .74       .65       .73       .71       .68       .61       .66       .58       .83       .66
                     .77       .77       .77       .76       .75       .76       .58       .74       .73       .60
                     .75       .66       .69       .55       .76       .69       .72       .74       .73       .63
                     .76      1.18      1.28      1.33      1.56      1.77       .86       .96      1.09      1.49
                    1.67      1.67      1.81      2.07      2.00      1.45      2.15      2.55      2.41      4.10
                   12.29      2.41      1.50      1.16      1.14       .86       .86       .89       .94       .72
                     .75       .72       .66       .86       .42       .84       .69       .86       .69       .69
                     .71       .69       .58       .64       .76       .71

 25 LS          SCS LOSS RATE
                      STRTL        .25  INITIAL ABSTRACTION
                     CRVNBR      89.00  CURVE NUMBER
                      RTIMP      80.00  PERCENT IMPERVIOUS AREA

 24 UC          CLARK UNITGRAPH
                         TC        .87  TIME OF CONCENTRATION
                          R        .22  STORAGE COEFFICIENT

                SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                    ***

                                              UNIT HYDROGRAPH PARAMETERS
                                        CLARK   TC=   .87 HR,       R=   .22 HR
                                       SNYDER   TP=   .57 HR,      CP=   .79

                                                 UNIT HYDROGRAPH
                                             7 END-OF-PERIOD ORDINATES
                61.      188.      252.      180.       70.       19.        5.
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HYDROGRAPH AT STATION DIRE

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DA MON HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q	*	DA MON HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q
20 NOV 0000	1	.00	.00	.00	0.	*	20 NOV 1500	61	.06	.00	.06	35.
20 NOV 0015	2	.01	.00	.01	1.	*	20 NOV 1515	62	.07	.00	.07	38.
20 NOV 0030	3	.01	.00	.01	3.	*	20 NOV 1530	63	.07	.00	.07	44.
20 NOV 0045	4	.01	.00	.01	5.	*	20 NOV 1545	64	.08	.00	.07	49.
20 NOV 0100	5	.02	.00	.01	6.	*	20 NOV 1600	65	.09	.00	.08	54.
20 NOV 0115	6	.02	.00	.01	7.	*	20 NOV 1615	66	.08	.00	.08	58.
20 NOV 0130	7	.02	.00	.02	9.	*	20 NOV 1630	67	.06	.00	.06	60.
20 NOV 0145	8	.02	.00	.02	11.	*	20 NOV 1645	68	.09	.00	.09	59.
20 NOV 0200	9	.02	.00	.02	12.	*	20 NOV 1700	69	.11	.00	.10	60.
20 NOV 0215	10	.02	.00	.01	12.	*	20 NOV 1715	70	.10	.00	.10	66.
20 NOV 0230	11	.02	.00	.02	12.	*	20 NOV 1730	71	.17	.00	.17	77.
20 NOV 0245	12	.02	.00	.01	12.	*	20 NOV 1745	72	.52	.01	.51	115.
20 NOV 0300	13	.02	.00	.02	12.	*	20 NOV 1800	73	.10	.00	.10	172.
20 NOV 0315	14	.03	.01	.02	12.	*	20 NOV 1815	74	.06	.00	.06	190.
20 NOV 0330	15	.03	.01	.02	13.	*	20 NOV 1830	75	.05	.00	.05	146.
20 NOV 0345	16	.03	.01	.02	14.	*	20 NOV 1845	76	.05	.00	.05	85.
20 NOV 0400	17	.03	.01	.02	16.	*	20 NOV 1900	77	.04	.00	.04	52.
20 NOV 0415	18	.04	.01	.03	17.	*	20 NOV 1915	78	.04	.00	.04	38.
20 NOV 0430	19	.03	.01	.03	19.	*	20 NOV 1930	79	.04	.00	.04	32.
20 NOV 0445	20	.04	.01	.03	21.	*	20 NOV 1945	80	.04	.00	.04	29.
20 NOV 0500	21	.04	.01	.03	22.	*	20 NOV 2000	81	.03	.00	.03	29.
20 NOV 0515	22	.03	.00	.03	23.	*	20 NOV 2015	82	.03	.00	.03	27.
20 NOV 0530	23	.03	.00	.02	23.	*	20 NOV 2030	83	.03	.00	.03	26.
20 NOV 0545	24	.03	.00	.03	22.	*	20 NOV 2045	84	.03	.00	.03	24.
20 NOV 0600	25	.03	.00	.03	20.	*	20 NOV 2100	85	.04	.00	.04	24.
20 NOV 0615	26	.03	.00	.03	20.	*	20 NOV 2115	86	.02	.00	.02	23.
20 NOV 0630	27	.03	.00	.02	20.	*	20 NOV 2130	87	.04	.00	.03	22.
20 NOV 0645	28	.03	.00	.02	19.	*	20 NOV 2145	88	.03	.00	.03	22.
20 NOV 0700	29	.02	.00	.02	19.	*	20 NOV 2200	89	.04	.00	.04	23.
20 NOV 0715	30	.04	.00	.03	19.	*	20 NOV 2215	90	.03	.00	.03	24.
20 NOV 0730	31	.03	.00	.02	20.	*	20 NOV 2230	91	.03	.00	.03	24.
20 NOV 0745	32	.03	.00	.03	21.	*	20 NOV 2245	92	.03	.00	.03	24.
20 NOV 0800	33	.03	.00	.03	21.	*	20 NOV 2300	93	.03	.00	.03	23.
20 NOV 0815	34	.03	.00	.03	22.	*	20 NOV 2315	94	.02	.00	.02	22.
20 NOV 0830	35	.03	.00	.03	22.	*	20 NOV 2330	95	.03	.00	.03	21.
20 NOV 0845	36	.03	.00	.03	23.	*	20 NOV 2345	96	.03	.00	.03	21.
20 NOV 0900	37	.03	.00	.03	23.	*	21 NOV 0000	97	.03	.00	.03	22.
20 NOV 0915	38	.02	.00	.02	22.	*	21 NOV 0015	98	.00	.00	.00	21.
20 NOV 0930	39	.03	.00	.03	21.	*	21 NOV 0030	99	.00	.00	.00	16.
20 NOV 0945	40	.03	.00	.03	21.	*	21 NOV 0045	100	.00	.00	.00	8.
20 NOV 1000	41	.03	.00	.02	21.	*	21 NOV 0100	101	.00	.00	.00	3.
20 NOV 1015	42	.03	.00	.03	21.	*	21 NOV 0115	102	.00	.00	.00	1.
20 NOV 1030	43	.03	.00	.03	21.	*	21 NOV 0130	103	.00	.00	.00	0.
20 NOV 1045	44	.03	.00	.03	21.	*	21 NOV 0145	104	.00	.00	.00	0.
20 NOV 1100	45	.02	.00	.02	21.	*	21 NOV 0200	105	.00	.00	.00	0.
20 NOV 1115	46	.03	.00	.03	20.	*	21 NOV 0215	106	.00	.00	.00	0.
20 NOV 1130	47	.03	.00	.03	20.	*	21 NOV 0230	107	.00	.00	.00	0.
20 NOV 1145	48	.03	.00	.03	21.	*	21 NOV 0245	108	.00	.00	.00	0.
20 NOV 1200	49	.03	.00	.03	22.	*	21 NOV 0300	109	.00	.00	.00	0.
20 NOV 1215	50	.03	.00	.03	22.	*	21 NOV 0315	110	.00	.00	.00	0.
20 NOV 1230	51	.03	.00	.03	22.	*	21 NOV 0330	111	.00	.00	.00	0.
20 NOV 1245	52	.03	.00	.03	22.	*	21 NOV 0345	112	.00	.00	.00	0.
20 NOV 1300	53	.05	.00	.05	23.	*	21 NOV 0400	113	.00	.00	.00	0.
20 NOV 1315	54	.05	.00	.05	27.	*	21 NOV 0415	114	.00	.00	.00	0.
20 NOV 1330	55	.06	.00	.05	33.	*	21 NOV 0430	115	.00	.00	.00	0.
20 NOV 1345	56	.07	.00	.06	38.	*	21 NOV 0445	116	.00	.00	.00	0.

20 NOV 1400	57	.07	.00	.07	43.	*	21 NOV 0500	117	.00	.00	.00	0.
20 NOV 1415	58	.04	.00	.03	46.	*	21 NOV 0515	118	.00	.00	.00	0.
20 NOV 1430	59	.04	.00	.04	43.	*	21 NOV 0530	119	.00	.00	.00	0.
20 NOV 1445	60	.05	.00	.04	37.	*	21 NOV 0545	120	.00	.00	.00	0.

TOTAL RAINFALL = 4.22, TOTAL LOSS = .24, TOTAL EXCESS = 3.98

PEAK FLOW (CFS)	TIME (HR)	MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	29.75-HR
+		(CFS)			
+ 190.	18.25	68.	32.	26.	26.
		(INCHES) 2.107	3.954	3.972	3.972
		(AC-FT) 34.	63.	64.	64.

CUMULATIVE AREA = .30 SQ MI

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            **************
            *            *
  26 KK     *      INFL  *     OW
            *            *
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27 HC HYDROGRAPH COMBINATION
ICOMP 2 NUMBER OF HYDROGRAPHS TO COMBINE

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HYDROGRAPH AT STATION INFL
SUM OF 2 HYDROGRAPHS

DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW
20 NOV 0000	1	0.	20 NOV 0730	31	33.	20 NOV 1500	61	61.	20 NOV 2230	91	43.
20 NOV 0015	2	1.	20 NOV 0745	32	35.	20 NOV 1515	62	67.	20 NOV 2245	92	41.
20 NOV 0030	3	4.	20 NOV 0800	33	36.	20 NOV 1530	63	77.	20 NOV 2300	93	40.
20 NOV 0045	4	8.	20 NOV 0815	34	37.	20 NOV 1545	64	85.	20 NOV 2315	94	39.
20 NOV 0100	5	10.	20 NOV 0830	35	38.	20 NOV 1600	65	93.	20 NOV 2330	95	38.
20 NOV 0115	6	12.	20 NOV 0845	36	39.	20 NOV 1615	66	100.	20 NOV 2345	96	37.
20 NOV 0130	7	15.	20 NOV 0900	37	39.	20 NOV 1630	67	104.	21 NOV 0000	97	38.
20 NOV 0145	8	17.	20 NOV 0915	38	38.	20 NOV 1645	68	102.	21 NOV 0015	98	36.
20 NOV 0200	9	19.	20 NOV 0930	39	37.	20 NOV 1700	69	106.	21 NOV 0030	99	27.
20 NOV 0215	10	20.	20 NOV 0945	40	36.	20 NOV 1715	70	116.	21 NOV 0045	100	15.
20 NOV 0230	11	20.	20 NOV 1000	41	36.	20 NOV 1730	71	135.	21 NOV 0100	101	6.
20 NOV 0245	12	20.	20 NOV 1015	42	36.	20 NOV 1745	72	200.	21 NOV 0115	102	3.
20 NOV 0300	13	19.	20 NOV 1030	43	36.	20 NOV 1800	73	298.	21 NOV 0130	103	1.
20 NOV 0315	14	20.	20 NOV 1045	44	36.	20 NOV 1815	74	321.	21 NOV 0145	104	1.
20 NOV 0330	15	21.	20 NOV 1100	45	35.	20 NOV 1830	75	244.	21 NOV 0200	105	0.
20 NOV 0345	16	24.	20 NOV 1115	46	35.	20 NOV 1845	76	153.	21 NOV 0215	106	0.
20 NOV 0400	17	26.	20 NOV 1130	47	35.	20 NOV 1900	77	101.	21 NOV 0230	107	0.
20 NOV 0415	18	28.	20 NOV 1145	48	36.	20 NOV 1915	78	76.	21 NOV 0245	108	0.
20 NOV 0430	19	31.	20 NOV 1200	49	37.	20 NOV 1930	79	62.	21 NOV 0300	109	0.
20 NOV 0445	20	34.	20 NOV 1215	50	38.	20 NOV 1945	80	56.	21 NOV 0315	110	0.
20 NOV 0500	21	37.	20 NOV 1230	51	38.	20 NOV 2000	81	53.	21 NOV 0330	111	0.
20 NOV 0515	22	39.	20 NOV 1245	52	38.	20 NOV 2015	82	49.	21 NOV 0345	112	0.
20 NOV 0530	23	38.	20 NOV 1300	53	40.	20 NOV 2030	83	46.	21 NOV 0400	113	0.
20 NOV 0545	24	36.	20 NOV 1315	54	47.	20 NOV 2045	84	43.	21 NOV 0415	114	0.
20 NOV 0600	25	35.	20 NOV 1330	55	56.	20 NOV 2100	85	42.	21 NOV 0430	115	0.
20 NOV 0615	26	34.	20 NOV 1345	56	65.	20 NOV 2115	86	41.	21 NOV 0445	116	0.
20 NOV 0630	27	34.	20 NOV 1400	57	73.	20 NOV 2130	87	39.	21 NOV 0500	117	0.
20 NOV 0645	28	33.	20 NOV 1415	58	78.	20 NOV 2145	88	39.	21 NOV 0515	118	0.
20 NOV 0700	29	32.	20 NOV 1430	59	74.	20 NOV 2200	89	40.	21 NOV 0530	119	0.
20 NOV 0715	30	32.	20 NOV 1445	60	65.	20 NOV 2215	90	42.	21 NOV 0545	120	0.

PEAK FLOW (CFS)	TIME (HR)	MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	29.75-HR
+		(CFS)			
+ 321.	18.25	119.	56.	45.	45.
		(INCHES) 2.081	3.890	3.909	3.909
		(AC-FT) 59.	110.	111.	111.

CUMULATIVE AREA = .53 SQ MI

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            **************
            *            *
  28 KK     *      POND  *
            *            *
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DETENTION POND AND PUMP STATION (ENGINE DRIVEN PUMPS ONLY)

HYDROGRAPH ROUTING DATA

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30 RS          STORAGE ROUTING
                     NSTPS           1  NUMBER OF SUBREACHES
                      ITYP        ELEV  TYPE OF INITIAL CONDITION
                    RSVRIC        5.00  INITIAL CONDITION
                         X         .00 WORKING R AND D COEFFICIENT

31 SA              AREA         1.0       1.1       6.2       9.2      10.8     350.0

32 SE          ELEVATION        5.00      6.00      7.00      8.00      9.00     10.00

33 SS          SPILLWAY
                      CREL        9.00  SPILLWAY CREST ELEVATION
                     SPWID      215.00  SPILLWAY WIDTH
                      COQW        2.50  WEIR COEFFICIENT
                      EXPW        1.50  EXPONENT OF HEAD

34 WP          PUMPING DATA

                  PUMP ON    PUMPING    PUMP OFF
                 ELEVATION     RATE    ELEVATION

                      5.1       39.         1.0
                      5.6       39.         5.2

                     ISTAD              PUMP FLOW HYDROGRAPH IDENTIFICATION

                                                          ***

                                          COMPUTED STORAGE-ELEVATION DATA

          STORAGE        .00      1.06      4.33     11.95     21.91    162.65
        ELEVATION       5.00      6.00      7.00      8.00      9.00     10.00

                                          COMPUTED OUTFLOW-ELEVATION DATA

          OUTFLOW        .00       .00       .09       .74      2.49      5.90     11.52     19.91     31.61     47.19
        ELEVATION       5.00      9.00      9.00      9.01      9.03      9.05      9.08      9.11      9.15      9.20

          OUTFLOW      67.19     92.16    122.67    159.26    202.48    252.90    311.05    377.50    452.80    537.50
        ELEVATION       9.25      9.31      9.37      9.44      9.52      9.60      9.69      9.79      9.89     10.00

                                       COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE        .00      1.06      4.33     11.95     21.91     22.05     22.25     22.58     23.08     23.84
          OUTFLOW        .00       .00       .00       .00       .00       .74      2.49      5.90     11.52     19.91
        ELEVATION       5.00      6.00      7.00      8.00      9.00      9.01      9.03      9.05      9.08      9.11

          STORAGE      24.98     26.63     29.01     32.40     37.13     43.67     52.57     64.52     80.38    101.17
          OUTFLOW      31.61     47.19     67.19     92.16    122.67    159.26    202.48    252.90    311.05    377.50
        ELEVATION       9.15      9.20      9.25      9.31      9.37      9.44      9.52      9.60      9.69      9.79

          STORAGE     128.11    162.65
          OUTFLOW     452.80    537.50
        ELEVATION       9.89     10.00
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HYDROGRAPH AT STATION POND

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DA	MON	HRMN	ORD	PUMP Q	OUTFLOW	STORAGE	STAGE	*	DA	MON	HRMN	ORD	PUMP Q	OUTFLOW	STORAGE	STAGE
20	NOV	0000	1	0.	0.	.0	5.0	*	20	NOV	1500	61	77.	0.	.2	5.2
20	NOV	0015	2	0.	0.	.0	5.0	*	20	NOV	1515	62	39.	0.	.7	5.7
20	NOV	0030	3	0.	0.	.1	5.1	*	20	NOV	1530	63	77.	0.	.6	5.6
20	NOV	0045	4	0.	0.	.2	5.2	*	20	NOV	1545	64	77.	0.	.7	5.6
20	NOV	0100	5	39.	0.	.0	5.0	*	20	NOV	1600	65	77.	0.	.9	5.9
20	NOV	0115	6	0.	0.	.0	5.0	*	20	NOV	1615	66	77.	0.	1.3	6.2
20	NOV	0130	7	39.	0.	.0	5.0	*	20	NOV	1630	67	77.	0.	1.8	6.4
20	NOV	0145	8	0.	0.	.0	5.0	*	20	NOV	1645	68	77.	0.	2.3	6.6
20	NOV	0200	9	39.	0.	.0	5.0	*	20	NOV	1700	69	77.	0.	2.9	6.7
20	NOV	0215	10	39.	0.	.0	5.0	*	20	NOV	1715	70	77.	0.	3.6	6.9
20	NOV	0230	11	39.	0.	.0	5.0	*	20	NOV	1730	71	77.	0.	4.6	7.0
20	NOV	0245	12	39.	0.	.0	5.0	*	20	NOV	1745	72	77.	0.	6.5	7.3
20	NOV	0300	13	39.	0.	.0	5.0	*	20	NOV	1800	73	77.	0.	10.0	7.8
20	NOV	0315	14	39.	0.	.0	5.0	*	20	NOV	1815	74	77.	0.	14.8	8.3
20	NOV	0330	15	39.	0.	.0	5.0	*	20	NOV	1830	75	77.	0.	19.0	8.7
20	NOV	0345	16	39.	0.	.0	5.0	*	20	NOV	1845	76	77.	0.	21.5	9.0
20	NOV	0400	17	39.	0.	.0	5.0	*	20	NOV	1900	77	77.	5.	22.5	9.0
20	NOV	0415	18	39.	0.	.0	5.0	*	20	NOV	1915	78	77.	6.	22.6	9.1
20	NOV	0430	19	39.	0.	.0	5.0	*	20	NOV	1930	79	77.	3.	22.3	9.0
20	NOV	0445	20	39.	0.	.0	5.0	*	20	NOV	1945	80	77.	0.	21.9	9.0
20	NOV	0500	21	39.	0.	.0	5.0	*	20	NOV	2000	81	77.	0.	21.5	9.0
20	NOV	0515	22	39.	0.	.0	5.0	*	20	NOV	2015	82	77.	0.	20.9	8.9
20	NOV	0530	23	39.	0.	.0	5.0	*	20	NOV	2030	83	77.	0.	20.3	8.9
20	NOV	0545	24	39.	0.	.0	5.0	*	20	NOV	2045	84	77.	0.	19.6	8.8
20	NOV	0600	25	39.	0.	.0	5.0	*	20	NOV	2100	85	77.	0.	18.9	8.7
20	NOV	0615	26	39.	0.	.0	5.0	*	20	NOV	2115	86	77.	0.	18.2	8.6
20	NOV	0630	27	39.	0.	.0	5.0	*	20	NOV	2130	87	77.	0.	17.4	8.6
20	NOV	0645	28	39.	0.	.0	5.0	*	20	NOV	2145	88	77.	0.	16.6	8.5
20	NOV	0700	29	39.	0.	.0	5.0	*	20	NOV	2200	89	77.	0.	15.9	8.4
20	NOV	0715	30	39.	0.	.0	5.0	*	20	NOV	2215	90	77.	0.	15.1	8.3
20	NOV	0730	31	39.	0.	.0	5.0	*	20	NOV	2230	91	77.	0.	14.4	8.3
20	NOV	0745	32	39.	0.	.0	5.0	*	20	NOV	2245	92	77.	0.	13.7	8.2
20	NOV	0800	33	39.	0.	.0	5.0	*	20	NOV	2300	93	77.	0.	12.9	8.1

20 NOV 0815	34	39.	0.	.0	5.0	*	20 NOV 2315	94	77.	0.	12.2	8.0
20 NOV 0830	35	39.	0.	.0	5.0	*	20 NOV 2330	95	77.	0.	11.4	7.9
20 NOV 0845	36	39.	0.	.0	5.0	*	20 NOV 2345	96	77.	0.	10.6	7.8
20 NOV 0900	37	39.	0.	.0	5.0	*	21 NOV 0000	97	77.	0.	9.7	7.7
20 NOV 0915	38	39.	0.	.0	5.0	*	21 NOV 0015	98	77.	0.	8.9	7.6
20 NOV 0930	39	39.	0.	.0	5.0	*	21 NOV 0030	99	77.	0.	8.0	7.5
20 NOV 0945	40	39.	0.	.0	5.0	*	21 NOV 0045	100	77.	0.	6.8	7.4
20 NOV 1000	41	39.	0.	.0	5.0	*	21 NOV 0100	101	77.	0.	5.5	7.2
20 NOV 1015	42	39.	0.	.0	5.0	*	21 NOV 0115	102	77.	0.	4.0	6.9
20 NOV 1030	43	39.	0.	.0	5.0	*	21 NOV 0130	103	77.	0.	2.4	6.6
20 NOV 1045	44	39.	0.	.0	5.0	*	21 NOV 0145	104	77.	0.	.9	5.8
20 NOV 1100	45	39.	0.	.0	5.0	*	21 NOV 0200	105	77.	0.	.0	5.0
20 NOV 1115	46	39.	0.	.0	5.0	*	21 NOV 0215	106	0.	0.	.0	5.0
20 NOV 1130	47	39.	0.	.0	5.0	*	21 NOV 0230	107	39.	0.	.0	5.0
20 NOV 1145	48	39.	0.	.0	5.0	*	21 NOV 0245	108	0.	0.	.0	5.0
20 NOV 1200	49	39.	0.	.0	5.0	*	21 NOV 0300	109	0.	0.	.0	5.0
20 NOV 1215	50	39.	0.	.0	5.0	*	21 NOV 0315	110	0.	0.	.0	5.0
20 NOV 1230	51	39.	0.	.0	5.0	*	21 NOV 0330	111	0.	0.	.0	5.0
20 NOV 1245	52	39.	0.	.0	5.0	*	21 NOV 0345	112	0.	0.	.0	5.0
20 NOV 1300	53	39.	0.	.0	5.0	*	21 NOV 0400	113	0.	0.	.0	5.0
20 NOV 1315	54	39.	0.	.1	5.1	*	21 NOV 0415	114	0.	0.	.0	5.0
20 NOV 1330	55	39.	0.	.4	5.4	*	21 NOV 0430	115	0.	0.	.0	5.0
20 NOV 1345	56	39.	0.	.8	5.8	*	21 NOV 0445	116	0.	0.	.0	5.0
20 NOV 1400	57	77.	0.	.7	5.6	*	21 NOV 0500	117	0.	0.	.0	5.0
20 NOV 1415	58	77.	0.	.6	5.6	*	21 NOV 0515	118	0.	0.	.0	5.0
20 NOV 1430	59	77.	0.	.6	5.6	*	21 NOV 0530	119	0.	0.	.0	5.0
20 NOV 1445	60	77.	0.	.5	5.4	*	21 NOV 0545	120	0.	0.	.0	5.0
						*						

****

PEAK OUTFLOW IS 6. AT TIME 19.25 HOURS

***** PUMP FLOW HYDROGRAPH *****

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	29.75-HR
		(CFS)				
77.	14.00		77.	58.	48.	48.
		(INCHES)	1.350	4.035	4.161	4.161
		(AC-FT)	38.	114.	118.	118.

***** OUTFLOW HYDROGRAPH *****

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	29.75-HR
		(CFS)				
6.	19.25		1.	0.	0.	0.
		(INCHES)	.011	.011	.011	.011
		(AC-FT)	0.	0.	0.	0.

PEAK STORAGE (AC-FT)	TIME (HR)	MAXIMUM AVERAGE STORAGE 6-HR	24-HR	72-HR	29.75-HR
23.	19.25	17.	5.	4.	4.

PEAK STAGE (FEET)	TIME (HR)	MAXIMUM AVERAGE STAGE 6-HR	24-HR	72-HR	29.75-HR
9.05	19.25	8.54	6.25	6.01	6.01

CUMULATIVE AREA = .53 SQ MI

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	WEST	131.	18.25	51.	24.	19.	.23		
HYDROGRAPH AT	DIRE	190.	18.25	68.	32.	26.	.30		
2 COMBINED AT	INFL	321.	18.25	119.	56.	45.	.53		
PUMP FLOW TO		77.	14.00	77.	58.	48.	.53		
HYDROGRAPH AT	POND	6.	19.25	1.	0.	0.	.53		
								9.05	19.25

*** NORMAL END OF HEC-1 ***

Spreadsheet C.4: Crittenden Pump Station

Intensity (from Santa Clara County Drainage Manual)

Intensity

I = K/t^n
I = Intensity
k = 1.008
MAP = 14
Q = kCiA
100-yr K = 1.02
n = 0.52

Velocity (Mannings)

Sf = ((Q*n)/(1.49*A*R^(2/3)))^2
V = Q/A
V = Velocity, ft/s
R = hydraulic radius, ft (A/P)
A = cross-sectional flow area, sf (pipe area since assuming flowing full)
P = Wetted perimeter, ft (pipe perimeter since assuming flowing full)
Sf = Friction slope,
n = 0.013

Flow

Q = kCiA
k = 1.008

ID/Name	Land Use Coeff	Time of Concentration min	DA acres	C x A acres	Cumulative DA acres	100-yr intensity in/hr	100-yr Q cfs	Pipe Length ft	Pipe diam in	Pipe area sf	Pipe P ft	Pipe R ft	100-year Velocity fps	Pipe invert ft	Pipe Slope ft/ft	Pipe Capacity cfs	Surplus flow cfs
1 1-2	0.53	14.10	5.23	2.77	2.77	2.17	6.05	500.00	24	3.14	6.28	0.50	1.92	7.6	0.00120	7.86	-1.81
2 2-3	0.53	18.43	1.15	0.61	3.38	1.88	3.40	366.00	24	3.14	6.28	0.50	1.08	7.0	0.00601	17.59	-14.19
3 3-4	0.73	24.07	13.92	10.16	13.54	1.64	16.34	474.00	24	3.14	6.28	0.50	5.20	4.8	0.00823	20.58	-4.24
4 4-5	0.45	25.59	3.57	1.61	15.15	1.59	10.92	957.30	24	3.14	6.28	0.50	3.47	0.9	0.00303	12.48	-1.57
5 5-6	0.67	30.18	7.32	4.90	20.05	1.46	19.74	689.00	66	23.76	17.28	1.38	0.83	-2.0	0.00261	172.10	-152.36
6 6-7	0.81	44.00	11.81	9.56	29.61	1.20	28.98	143.00	66	23.76	17.28	1.38	1.22	-3.8 -8.5	0.03287	610.44	-581.46
			42.99														

INFLOW HYDROGRAPH TO CRITTENDEN PUMP STATION

```
1****************************************                                                    ****************************************
 *                                      *                                                    *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                                    *    U.S. ARMY CORPS OF ENGINEERS      *
 *             JUN   1998               *                                                    *    HYDROLOGIC ENGINEERING CENTER     *
 *           VERSION 4.1                *                                                    *          609 SECOND STREET           *
 *                                      *                                                    *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   13JAN09  TIME  13:55:12  *                                                    *           (916) 756-1104             *
 *                                      *                                                    *                                      *
 ****************************************                                                    ****************************************


                                                X     X  XXXXXXX   XXXXX           X
                                                X     X  X        X     X         XX
                                                X     X  X        X                X
                                                XXXXXXX  XXXX     X        XXXXX   X
                                                X     X  X        X                X
                                                X     X  X        X     X          X
                                                X     X  XXXXXXX   XXXXX         XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                                   HEC-1 INPUT                                                   PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1           ID   Stevens Creek Hydrograph Routing - Crittenden Pump Station
            2           ID   Emily Caldwell, Schaaf & Wheeler, November 19, 2008
            3           IT      15 20NOV98       0     120
            4           IO       1
                        *

            5           KK    CHARL CHARLESTON OVERFLOW
            6           QI       0       0       0       0       0       0       0       0       0       0
            7           QI       0       0       0       0       0       0       0       0       0       0
            8           QI       0       0       0       0       0       0       0       0       0       0
            9           QI       0       0       0       0       0       0       0       0       0       0
           10           QI       0       0       0       0       0       0       0       0       0       0
           11           QI       0       0       0       0       0       0       0       0       0       0
           12           QI       0       0       0       0       0       0       0       0       0       0
           13           QI       0       0       0       0       0       0       5       6       3       0
                        *

           14           KK    STORM DRAIN TO CRITTENDEN PS
           15           BA    .067
           16           PB    4.22
           17           PI    0.32    0.28    0.20    0.38    0.43    0.48    0.48    0.50    0.43    0.48
           18           PI    0.41    0.45    0.60    0.61    0.65    0.69    0.84    0.76    0.90    0.91
           19           PI    0.74    0.65    0.73    0.71    0.68    0.61    0.66    0.58    0.83    0.66
           20           PI    0.77    0.77    0.77    0.76    0.75    0.76    0.58    0.74    0.73    0.60
           21           PI    0.75    0.66    0.69    0.55    0.76    0.69    0.72    0.74    0.73    0.63
           22           PI    0.76    1.18    1.28    1.33    1.56    1.77    0.86    0.96    1.09    1.49
           23           PI    1.67    1.67    1.81    2.07    2.00    1.45    2.15    2.55    2.41    4.10
           24           PI   12.29    2.41    1.50    1.16    1.14    0.86    0.86    0.89    0.94    0.72
           25           PI    0.75    0.72    0.66    0.86    0.42    0.84    0.69    0.86    0.69    0.69
           26           PI    0.71    0.69    0.58    0.64    0.76    0.71
                        *
           27           UC     .73     .73
           28           LS       0      89      59
                        *

           29           KK    OVERLAND FLOW TO CRITTENDEN PS
           30           BA    .159
                        *
           31           UC    1.37    2.54
           32           LS       0      89       5
                        *

           33           KK    TOTAL
           34           HC       3
                        *
           35           ZZ
```

```
1****************************************                                                    ****************************************
 *                                      *                                                    *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                                    *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998              *                                                    *    HYDROLOGIC ENGINEERING CENTER     *
 *            VERSION 4.1               *                                                    *          609 SECOND STREET           *
 *                                      *                                                    *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   13JAN09  TIME  13:55:12  *                                                    *           (916) 756-1104             *
 *                                      *                                                    *                                      *
 ****************************************                                                    ****************************************


                         Stevens Creek Hydrograph Routing - Crittenden Pump Station
                         Emily Caldwell, Schaaf & Wheeler, November 19, 2008

   4 IO          OUTPUT CONTROL VARIABLES
                       IPRNT           1  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                        NMIN          15  MINUTES IN COMPUTATION INTERVAL
                       IDATE     20NOV98  STARTING DATE
                       ITIME        0000  STARTING TIME
                          NQ         120  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE     21NOV98  ENDING DATE
                      NDTIME        0545  ENDING TIME
                      ICENT          19  CENTURY MARK

                  COMPUTATION INTERVAL     .25 HOURS
                       TOTAL TIME BASE   29.75 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   5 KK     *      CHAR  *     L CHARLESTON OVERFLOW
            *            *
            **************

               SUBBASIN RUNOFF DATA

   0 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .00  SUBBASIN AREA
                                                                  ***
*****************************************************************************************************************************************

                                                   HYDROGRAPH AT STATION     CHAR
*****************************************************************************************************************************************
                                 *                                 *                                 *
   DA MON HRMN  ORD      FLOW    *   DA MON HRMN  ORD      FLOW    *   DA MON HRMN  ORD      FLOW    *   DA MON HRMN  ORD      FLOW
                                 *                                 *                                 *
   20 NOV 0000    1        0.    *   20 NOV 0730   31        0.    *   20 NOV 1500   61        0.    *   20 NOV 2230   91        3.
   20 NOV 0015    2        0.    *   20 NOV 0745   32        0.    *   20 NOV 1515   62        0.    *   20 NOV 2245   92        3.
   20 NOV 0030    3        0.    *   20 NOV 0800   33        0.    *   20 NOV 1530   63        0.    *   20 NOV 2300   93        3.
   20 NOV 0045    4        0.    *   20 NOV 0815   34        0.    *   20 NOV 1545   64        0.    *   20 NOV 2315   94        3.
   20 NOV 0100    5        0.    *   20 NOV 0830   35        0.    *   20 NOV 1600   65        0.    *   20 NOV 2330   95        3.
   20 NOV 0115    6        0.    *   20 NOV 0845   36        0.    *   20 NOV 1615   66        0.    *   20 NOV 2345   96        3.
   20 NOV 0130    7        0.    *   20 NOV 0900   37        0.    *   20 NOV 1630   67        0.    *   21 NOV 0000   97        3.
   20 NOV 0145    8        0.    *   20 NOV 0915   38        0.    *   20 NOV 1645   68        0.    *   21 NOV 0015   98        3.
   20 NOV 0200    9        0.    *   20 NOV 0930   39        0.    *   20 NOV 1700   69        0.    *   21 NOV 0030   99        3.
   20 NOV 0215   10        0.    *   20 NOV 0945   40        0.    *   20 NOV 1715   70        0.    *   21 NOV 0045  100        3.
   20 NOV 0230   11        0.    *   20 NOV 1000   41        0.    *   20 NOV 1730   71        0.    *   21 NOV 0100  101        3.
   20 NOV 0245   12        0.    *   20 NOV 1015   42        0.    *   20 NOV 1745   72        0.    *   21 NOV 0115  102        3.
   20 NOV 0300   13        0.    *   20 NOV 1030   43        0.    *   20 NOV 1800   73        0.    *   21 NOV 0130  103        3.
   20 NOV 0315   14        0.    *   20 NOV 1045   44        0.    *   20 NOV 1815   74        0.    *   21 NOV 0145  104        3.
   20 NOV 0330   15        0.    *   20 NOV 1100   45        0.    *   20 NOV 1830   75        0.    *   21 NOV 0200  105        3.
   20 NOV 0345   16        0.    *   20 NOV 1115   46        0.    *   20 NOV 1845   76        0.    *   21 NOV 0215  106        3.
   20 NOV 0400   17        0.    *   20 NOV 1130   47        0.    *   20 NOV 1900   77        5.    *   21 NOV 0230  107        3.
   20 NOV 0415   18        0.    *   20 NOV 1145   48        0.    *   20 NOV 1915   78        6.    *   21 NOV 0245  108        3.
   20 NOV 0430   19        0.    *   20 NOV 1200   49        0.    *   20 NOV 1930   79        3.    *   21 NOV 0300  109        3.
   20 NOV 0445   20        0.    *   20 NOV 1215   50        0.    *   20 NOV 1945   80        3.    *   21 NOV 0315  110        3.
   20 NOV 0500   21        0.    *   20 NOV 1230   51        0.    *   20 NOV 2000   81        3.    *   21 NOV 0330  111        3.
   20 NOV 0515   22        0.    *   20 NOV 1245   52        0.    *   20 NOV 2015   82        3.    *   21 NOV 0345  112        3.
   20 NOV 0530   23        0.    *   20 NOV 1300   53        0.    *   20 NOV 2030   83        3.    *   21 NOV 0400  113        3.
   20 NOV 0545   24        0.    *   20 NOV 1315   54        0.    *   20 NOV 2045   84        3.    *   21 NOV 0415  114        3.
   20 NOV 0600   25        0.    *   20 NOV 1330   55        0.    *   20 NOV 2100   85        3.    *   21 NOV 0430  115        3.
   20 NOV 0615   26        0.    *   20 NOV 1345   56        0.    *   20 NOV 2115   86        3.    *   21 NOV 0445  116        3.
   20 NOV 0630   27        0.    *   20 NOV 1400   57        0.    *   20 NOV 2130   87        3.    *   21 NOV 0500  117        3.
   20 NOV 0645   28        0.    *   20 NOV 1415   58        0.    *   20 NOV 2145   88        3.    *   21 NOV 0515  118        3.
   20 NOV 0700   29        0.    *   20 NOV 1430   59        0.    *   20 NOV 2200   89        3.    *   21 NOV 0530  119        3.
   20 NOV 0715   30        0.    *   20 NOV 1445   60        0.    *   20 NOV 2215   90        3.    *   21 NOV 0545  120        3.
                                 *                                 *                                 *
```

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*****************************************************************************************************************************

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR       72-HR     29.75-HR
+  (CFS)       (HR)
                        (CFS)
+       6.     19.25                 3.          1.          1.          1.
                      (INCHES)     .000        .000        .000        .000
                       (AC-FT)       2.          3.          3.          3.

                       CUMULATIVE AREA =     .00 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  14 KK     *      STOR  *     M DRAIN TO CRITTENDEN PS
            *            *
            **************

              SUBBASIN RUNOFF DATA

  15 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .07  SUBBASIN AREA

                 PRECIPITATION DATA

  16 PB                STORM        4.22  BASIN TOTAL PRECIPITATION

  17 PI            INCREMENTAL PRECIPITATION PATTERN
                       .32       .28       .20       .38       .43       .48       .48       .50       .43       .48
                       .41       .45       .60       .61       .65       .69       .84       .76       .90       .91
                       .74       .65       .73       .71       .68       .61       .66       .58       .83       .66
                       .77       .77       .77       .76       .75       .76       .58       .74       .73       .60
                       .75       .66       .69       .55       .76       .69       .72       .74       .73       .63
                       .76      1.18      1.28      1.33      1.56      1.77       .86       .96      1.09      1.49
                      1.67      1.67      1.81      2.07      2.00      1.45      2.15      2.55      2.41      4.10
                     12.29      2.41      1.50      1.16      1.14       .86       .86       .89       .94       .72
                       .75       .72       .66       .86       .42       .84       .69       .86       .69       .69
                       .71       .69       .58       .64       .76       .71

  28 LS          SCS LOSS RATE
                       STRTL         .25  INITIAL ABSTRACTION
                      CRVNBR       89.00  CURVE NUMBER
                       RTIMP       59.00  PERCENT IMPERVIOUS AREA

  27 UC          CLARK UNITGRAPH
                          TC         .73  TIME OF CONCENTRATION
                           R         .73  STORAGE COEFFICIENT

                 SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                        ***

                                                UNIT HYDROGRAPH PARAMETERS
                                          CLARK   TC=   .73 HR,       R=   .73 HR
                                         SNYDER   TP=   .67 HR,      CP=   .57

                                                   UNIT HYDROGRAPH
                                              17 END-OF-PERIOD ORDINATES
                 7.       24.       35.       31.       22.       16.       11.        8.        6.        4.
                 3.        2.        1.        1.        1.        0.        0.

*****************************************************************************************************************************

                                                HYDROGRAPH AT STATION     STOR

*****************************************************************************************************************************
                                                                  *
       DA MON HRMN  ORD    RAIN    LOSS  EXCESS     COMP Q       *       DA MON HRMN  ORD    RAIN    LOSS  EXCESS     COMP Q
                                                                  *
       20 NOV 0000    1     .00     .00     .00         0.       *       20 NOV 1500   61     .06     .00     .06         8.
       20 NOV 0015    2     .01     .01     .01         0.       *       20 NOV 1515   62     .07     .01     .07         8.
       20 NOV 0030    3     .01     .00     .01         0.       *       20 NOV 1530   63     .07     .01     .07         9.
       20 NOV 0045    4     .01     .00     .00         0.       *       20 NOV 1545   64     .08     .01     .07         9.
       20 NOV 0100    5     .02     .01     .01         1.       *       20 NOV 1600   65     .09     .01     .08        10.
       20 NOV 0115    6     .02     .01     .01         1.       *       20 NOV 1615   66     .08     .01     .08        11.
       20 NOV 0130    7     .02     .01     .01         1.       *       20 NOV 1630   67     .06     .00     .06        12.
       20 NOV 0145    8     .02     .01     .01         1.       *       20 NOV 1645   68     .09     .01     .09        12.
       20 NOV 0200    9     .02     .01     .01         2.       *       20 NOV 1700   69     .11     .01     .10        12.
       20 NOV 0215   10     .02     .01     .01         2.       *       20 NOV 1715   70     .10     .01     .10        13.
       20 NOV 0230   11     .02     .01     .01         2.       *       20 NOV 1730   71     .17     .01     .17        15.
       20 NOV 0245   12     .02     .01     .01         2.       *       20 NOV 1745   72     .52     .02     .50        20.
       20 NOV 0300   13     .02     .01     .01         2.       *       20 NOV 1800   73     .10     .00     .10        28.
       20 NOV 0315   14     .03     .01     .01         2.       *       20 NOV 1815   74     .06     .00     .06        32.
       20 NOV 0330   15     .03     .01     .02         2.       *       20 NOV 1830   75     .05     .00     .05        29.
       20 NOV 0345   16     .03     .01     .02         2.       *       20 NOV 1845   76     .05     .00     .05        23.
       20 NOV 0400   17     .03     .01     .02         2.       *       20 NOV 1900   77     .04     .00     .04        19.
       20 NOV 0415   18     .04     .01     .02         3.       *       20 NOV 1915   78     .04     .00     .04        15.
       20 NOV 0430   19     .03     .01     .02         3.       *       20 NOV 1930   79     .04     .00     .04        13.
       20 NOV 0445   20     .04     .01     .03         3.       *       20 NOV 1945   80     .04     .00     .04        11.
       20 NOV 0500   21     .04     .01     .03         3.       *       20 NOV 2000   81     .03     .00     .03         9.
       20 NOV 0515   22     .03     .01     .02         4.       *       20 NOV 2015   82     .03     .00     .03         8.
       20 NOV 0530   23     .03     .01     .02         4.       *       20 NOV 2030   83     .03     .00     .03         8.
       20 NOV 0545   24     .03     .01     .02         4.       *       20 NOV 2045   84     .03     .00     .03         7.
       20 NOV 0600   25     .03     .01     .02         4.       *       20 NOV 2100   85     .04     .00     .04         6.
```

20 NOV 0615	26	.03	.01	.02	4.	*	20 NOV 2115	86	.02	.00	.02	6.
20 NOV 0630	27	.03	.01	.02	4.	*	20 NOV 2130	87	.04	.00	.03	6.
20 NOV 0645	28	.03	.01	.02	4.	*	20 NOV 2145	88	.03	.00	.03	5.
20 NOV 0700	29	.02	.01	.02	4.	*	20 NOV 2200	89	.04	.00	.04	5.
20 NOV 0715	30	.04	.01	.03	4.	*	20 NOV 2215	90	.03	.00	.03	5.
20 NOV 0730	31	.03	.01	.02	4.	*	20 NOV 2230	91	.03	.00	.03	5.
20 NOV 0745	32	.03	.01	.03	4.	*	20 NOV 2245	92	.03	.00	.03	5.
20 NOV 0800	33	.03	.01	.03	4.	*	20 NOV 2300	93	.03	.00	.03	5.
20 NOV 0815	34	.03	.01	.03	4.	*	20 NOV 2315	94	.02	.00	.02	5.
20 NOV 0830	35	.03	.01	.03	4.	*	20 NOV 2330	95	.03	.00	.03	5.
20 NOV 0845	36	.03	.01	.03	4.	*	20 NOV 2345	96	.03	.00	.03	5.
20 NOV 0900	37	.03	.01	.03	4.	*	21 NOV 0000	97	.03	.00	.03	5.
20 NOV 0915	38	.02	.00	.02	4.	*	21 NOV 0015	98	.00	.00	.00	5.
20 NOV 0930	39	.03	.01	.03	4.	*	21 NOV 0030	99	.00	.00	.00	4.
20 NOV 0945	40	.03	.00	.03	4.	*	21 NOV 0045	100	.00	.00	.00	3.
20 NOV 1000	41	.03	.00	.02	4.	*	21 NOV 0100	101	.00	.00	.00	2.
20 NOV 1015	42	.03	.00	.03	4.	*	21 NOV 0115	102	.00	.00	.00	2.
20 NOV 1030	43	.03	.00	.02	4.	*	21 NOV 0130	103	.00	.00	.00	1.
20 NOV 1045	44	.03	.00	.03	4.	*	21 NOV 0145	104	.00	.00	.00	1.
20 NOV 1100	45	.02	.00	.02	4.	*	21 NOV 0200	105	.00	.00	.00	1.
20 NOV 1115	46	.03	.00	.03	4.	*	21 NOV 0215	106	.00	.00	.00	0.
20 NOV 1130	47	.03	.00	.03	4.	*	21 NOV 0230	107	.00	.00	.00	0.
20 NOV 1145	48	.03	.00	.03	4.	*	21 NOV 0245	108	.00	.00	.00	0.
20 NOV 1200	49	.03	.00	.03	4.	*	21 NOV 0300	109	.00	.00	.00	0.
20 NOV 1215	50	.03	.00	.03	4.	*	21 NOV 0315	110	.00	.00	.00	0.
20 NOV 1230	51	.03	.00	.02	4.	*	21 NOV 0330	111	.00	.00	.00	0.
20 NOV 1245	52	.03	.00	.03	4.	*	21 NOV 0345	112	.00	.00	.00	0.
20 NOV 1300	53	.05	.01	.04	5.	*	21 NOV 0400	113	.00	.00	.00	0.
20 NOV 1315	54	.05	.01	.05	5.	*	21 NOV 0415	114	.00	.00	.00	0.
20 NOV 1330	55	.06	.01	.05	6.	*	21 NOV 0430	115	.00	.00	.00	0.
20 NOV 1345	56	.07	.01	.06	7.	*	21 NOV 0445	116	.00	.00	.00	0.
20 NOV 1400	57	.07	.01	.07	8.	*	21 NOV 0500	117	.00	.00	.00	0.
20 NOV 1415	58	.04	.00	.03	8.	*	21 NOV 0515	118	.00	.00	.00	0.
20 NOV 1430	59	.04	.00	.04	8.	*	21 NOV 0530	119	.00	.00	.00	0.
20 NOV 1445	60	.05	.00	.04	8.	*	21 NOV 0545	120	.00	.00	.00	0.
						*						

****

TOTAL RAINFALL = 4.22, TOTAL LOSS = .49, TOTAL EXCESS = 3.73

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	29.75-HR
+ (CFS)	(HR)					
		(CFS)				
+ 32.	18.25		14.	7.	5.	5.
		(INCHES)	1.981	3.681	3.714	3.714
		(AC-FT)	7.	13.	13.	13.

CUMULATIVE AREA = .07 SQ MI

*** ***

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              **************
              *            *
  29 KK       *      OVER  *     LAND FLOW TO CRITTENDEN PS
              *            *
              **************

                 SUBBASIN RUNOFF DATA

  30 BA            SUBBASIN CHARACTERISTICS
                        TAREA         .16  SUBBASIN AREA

                   PRECIPITATION DATA

  16 PB                 STORM        4.22  BASIN TOTAL PRECIPITATION

  17 PI              INCREMENTAL PRECIPITATION PATTERN
                        .32       .28       .20       .38       .43       .48       .48       .50       .43       .48
                        .41       .45       .60       .61       .65       .69       .84       .76       .90       .91
                        .74       .65       .73       .71       .68       .61       .66       .58       .83       .66
                        .77       .77       .77       .76       .75       .76       .58       .74       .73       .60
                        .75       .66       .69       .55       .76       .69       .72       .74       .73       .63
                        .76      1.18      1.28      1.33      1.56      1.77       .86       .96      1.09      1.49
                       1.67      1.67      1.81      2.07      2.00      1.45      2.15      2.55      2.41      4.10
                      12.29      2.41      1.50      1.16      1.14       .86       .86       .89       .94       .72
                        .75       .72       .66       .86       .42       .84       .69       .86       .69       .69
                        .71       .69       .58       .64       .76       .71

  32 LS            SCS LOSS RATE
                        STRTL         .25  INITIAL ABSTRACTION
                       CRVNBR       89.00  CURVE NUMBER
                        RTIMP        5.00  PERCENT IMPERVIOUS AREA

  31 UC            CLARK UNITGRAPH
                           TC        1.37  TIME OF CONCENTRATION
                            R        2.54  STORAGE COEFFICIENT

                   SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                          ***

                                                UNIT HYDROGRAPH PARAMETERS
                                          CLARK   TC=  1.37 HR,       R=  2.54 HR
                                         SNYDER   TP=  1.31 HR,      CP=   .39
```

UNIT HYDROGRAPH
57 END-OF-PERIOD ORDINATES

2.	8.	16.	24.	29.	30.	28.	26.	23.	21.
19.	17.	16.	14.	13.	12.	11.	10.	9.	8.
7.	6.	6.	5.	5.	4.	4.	4.	3.	3.
3.	2.	2.	2.	2.	2.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.			

HYDROGRAPH AT STATION OVER

DA MON HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q	DA MON HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q
20 NOV 0000	1	.00	.00	.00	0.	20 NOV 1500	61	.06	.01	.05	12.
20 NOV 0015	2	.01	.01	.00	0.	20 NOV 1515	62	.07	.01	.06	13.
20 NOV 0030	3	.01	.01	.00	0.	20 NOV 1530	63	.07	.01	.06	13.
20 NOV 0045	4	.01	.01	.00	0.	20 NOV 1545	64	.08	.01	.06	14.
20 NOV 0100	5	.02	.02	.00	0.	20 NOV 1600	65	.09	.01	.07	15.
20 NOV 0115	6	.02	.02	.00	0.	20 NOV 1615	66	.08	.01	.07	16.
20 NOV 0130	7	.02	.02	.00	0.	20 NOV 1630	67	.06	.01	.05	17.
20 NOV 0145	8	.02	.02	.00	0.	20 NOV 1645	68	.09	.01	.08	18.
20 NOV 0200	9	.02	.02	.00	0.	20 NOV 1700	69	.11	.01	.09	19.
20 NOV 0215	10	.02	.02	.00	0.	20 NOV 1715	70	.10	.01	.09	20.
20 NOV 0230	11	.02	.02	.00	0.	20 NOV 1730	71	.17	.02	.15	21.
20 NOV 0245	12	.02	.02	.00	0.	20 NOV 1745	72	.52	.05	.47	24.
20 NOV 0300	13	.02	.02	.00	0.	20 NOV 1800	73	.10	.01	.09	28.
20 NOV 0315	14	.03	.02	.00	0.	20 NOV 1815	74	.06	.00	.06	33.
20 NOV 0330	15	.03	.02	.00	0.	20 NOV 1830	75	.05	.00	.05	37.
20 NOV 0345	16	.03	.03	.00	0.	20 NOV 1845	76	.05	.00	.04	39.
20 NOV 0400	17	.03	.03	.00	0.	20 NOV 1900	77	.04	.00	.03	40.
20 NOV 0415	18	.04	.03	.01	0.	20 NOV 1915	78	.04	.00	.03	38.
20 NOV 0430	19	.03	.03	.01	0.	20 NOV 1930	79	.04	.00	.04	36.
20 NOV 0445	20	.04	.03	.01	1.	20 NOV 1945	80	.04	.00	.04	34.
20 NOV 0500	21	.04	.03	.01	1.	20 NOV 2000	81	.03	.00	.03	32.
20 NOV 0515	22	.03	.02	.01	1.	20 NOV 2015	82	.03	.00	.03	31.
20 NOV 0530	23	.03	.02	.01	1.	20 NOV 2030	83	.03	.00	.03	29.
20 NOV 0545	24	.03	.02	.01	1.	20 NOV 2045	84	.03	.00	.03	27.
20 NOV 0600	25	.03	.02	.01	2.	20 NOV 2100	85	.04	.00	.03	26.
20 NOV 0615	26	.03	.02	.01	2.	20 NOV 2115	86	.02	.00	.02	25.
20 NOV 0630	27	.03	.01	.01	2.	20 NOV 2130	87	.04	.00	.03	23.
20 NOV 0645	28	.03	.02	.01	2.	20 NOV 2145	88	.03	.00	.03	22.
20 NOV 0700	29	.02	.01	.01	3.	20 NOV 2200	89	.04	.00	.03	21.
20 NOV 0715	30	.04	.02	.02	3.	20 NOV 2215	90	.03	.00	.03	20.
20 NOV 0730	31	.03	.01	.01	3.	20 NOV 2230	91	.03	.00	.03	20.
20 NOV 0745	32	.03	.02	.02	3.	20 NOV 2245	92	.03	.00	.03	19.
20 NOV 0800	33	.03	.01	.02	4.	20 NOV 2300	93	.03	.00	.03	18.
20 NOV 0815	34	.03	.01	.02	4.	20 NOV 2315	94	.02	.00	.02	18.
20 NOV 0830	35	.03	.01	.02	4.	20 NOV 2330	95	.03	.00	.03	17.
20 NOV 0845	36	.03	.01	.02	4.	20 NOV 2345	96	.03	.00	.03	16.
20 NOV 0900	37	.03	.01	.02	5.	21 NOV 0000	97	.03	.00	.03	16.
20 NOV 0915	38	.02	.01	.02	5.	21 NOV 0015	98	.00	.00	.00	15.
20 NOV 0930	39	.03	.01	.02	5.	21 NOV 0030	99	.00	.00	.00	15.
20 NOV 0945	40	.03	.01	.02	5.	21 NOV 0045	100	.00	.00	.00	14.
20 NOV 1000	41	.03	.01	.02	6.	21 NOV 0100	101	.00	.00	.00	13.
20 NOV 1015	42	.03	.01	.02	6.	21 NOV 0115	102	.00	.00	.00	12.
20 NOV 1030	43	.03	.01	.02	6.	21 NOV 0130	103	.00	.00	.00	11.
20 NOV 1045	44	.03	.01	.02	6.	21 NOV 0145	104	.00	.00	.00	10.
20 NOV 1100	45	.02	.01	.02	6.	21 NOV 0200	105	.00	.00	.00	9.
20 NOV 1115	46	.03	.01	.02	6.	21 NOV 0215	106	.00	.00	.00	8.
20 NOV 1130	47	.03	.01	.02	7.	21 NOV 0230	107	.00	.00	.00	7.
20 NOV 1145	48	.03	.01	.02	7.	21 NOV 0245	108	.00	.00	.00	7.
20 NOV 1200	49	.03	.01	.02	7.	21 NOV 0300	109	.00	.00	.00	6.
20 NOV 1215	50	.03	.01	.02	7.	21 NOV 0315	110	.00	.00	.00	5.
20 NOV 1230	51	.03	.01	.02	7.	21 NOV 0330	111	.00	.00	.00	5.
20 NOV 1245	52	.03	.01	.02	7.	21 NOV 0345	112	.00	.00	.00	4.
20 NOV 1300	53	.05	.01	.04	7.	21 NOV 0400	113	.00	.00	.00	4.
20 NOV 1315	54	.05	.01	.04	8.	21 NOV 0415	114	.00	.00	.00	4.
20 NOV 1330	55	.06	.01	.04	8.	21 NOV 0430	115	.00	.00	.00	3.
20 NOV 1345	56	.07	.01	.05	9.	21 NOV 0445	116	.00	.00	.00	3.
20 NOV 1400	57	.07	.02	.06	10.	21 NOV 0500	117	.00	.00	.00	3.
20 NOV 1415	58	.04	.01	.03	10.	21 NOV 0515	118	.00	.00	.00	2.
20 NOV 1430	59	.04	.01	.03	11.	21 NOV 0530	119	.00	.00	.00	2.
20 NOV 1445	60	.05	.01	.04	12.	21 NOV 0545	120	.00	.00	.00	2.

TOTAL RAINFALL = 4.22, TOTAL LOSS = 1.13, TOTAL EXCESS = 3.09

	PEAK FLOW (CFS)	TIME (HR)	MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	29.75-HR
+	40.	19.00	(CFS) 28.	13.	10.	10.
			(INCHES) 1.617	3.019	3.036	3.036
			(AC-FT) 14.	26.	26.	26.

CUMULATIVE AREA = .16 SQ MI

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* *

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 33 KK      *      TOTA  *     L
            *            *
            **************

 34 HC          HYDROGRAPH COMBINATION
                     ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE
                                                                  ***
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HYDROGRAPH AT STATION TOTA
SUM OF 3 HYDROGRAPHS

DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW
20 NOV 0000	1	0.	20 NOV 0730	31	7.	20 NOV 1500	61	20.	20 NOV 2230	91	28.
20 NOV 0015	2	0.	20 NOV 0745	32	7.	20 NOV 1515	62	21.	20 NOV 2245	92	27.
20 NOV 0030	3	0.	20 NOV 0800	33	8.	20 NOV 1530	63	22.	20 NOV 2300	93	26.
20 NOV 0045	4	0.	20 NOV 0815	34	8.	20 NOV 1545	64	23.	20 NOV 2315	94	26.
20 NOV 0100	5	1.	20 NOV 0830	35	8.	20 NOV 1600	65	25.	20 NOV 2330	95	25.
20 NOV 0115	6	1.	20 NOV 0845	36	9.	20 NOV 1615	66	27.	20 NOV 2345	96	24.
20 NOV 0130	7	1.	20 NOV 0900	37	9.	20 NOV 1630	67	28.	21 NOV 0000	97	24.
20 NOV 0145	8	1.	20 NOV 0915	38	9.	20 NOV 1645	68	30.	21 NOV 0015	98	23.
20 NOV 0200	9	2.	20 NOV 0930	39	10.	20 NOV 1700	69	31.	21 NOV 0030	99	22.
20 NOV 0215	10	2.	20 NOV 0945	40	10.	20 NOV 1715	70	33.	21 NOV 0045	100	20.
20 NOV 0230	11	2.	20 NOV 1000	41	10.	20 NOV 1730	71	36.	21 NOV 0100	101	18.
20 NOV 0245	12	2.	20 NOV 1015	42	10.	20 NOV 1745	72	43.	21 NOV 0115	102	16.
20 NOV 0300	13	2.	20 NOV 1030	43	10.	20 NOV 1800	73	55.	21 NOV 0130	103	15.
20 NOV 0315	14	2.	20 NOV 1045	44	10.	20 NOV 1815	74	64.	21 NOV 0145	104	14.
20 NOV 0330	15	2.	20 NOV 1100	45	10.	20 NOV 1830	75	66.	21 NOV 0200	105	12.
20 NOV 0345	16	2.	20 NOV 1115	46	11.	20 NOV 1845	76	63.	21 NOV 0215	106	11.
20 NOV 0400	17	3.	20 NOV 1130	47	11.	20 NOV 1900	77	64.	21 NOV 0230	107	11.
20 NOV 0415	18	3.	20 NOV 1145	48	11.	20 NOV 1915	78	60.	21 NOV 0245	108	10.
20 NOV 0430	19	3.	20 NOV 1200	49	11.	20 NOV 1930	79	52.	21 NOV 0300	109	9.
20 NOV 0445	20	4.	20 NOV 1215	50	11.	20 NOV 1945	80	48.	21 NOV 0315	110	8.
20 NOV 0500	21	4.	20 NOV 1230	51	12.	20 NOV 2000	81	45.	21 NOV 0330	111	8.
20 NOV 0515	22	5.	20 NOV 1245	52	12.	20 NOV 2015	82	42.	21 NOV 0345	112	7.
20 NOV 0530	23	5.	20 NOV 1300	53	12.	20 NOV 2030	83	40.	21 NOV 0400	113	7.
20 NOV 0545	24	5.	20 NOV 1315	54	13.	20 NOV 2045	84	37.	21 NOV 0415	114	7.
20 NOV 0600	25	5.	20 NOV 1330	55	14.	20 NOV 2100	85	35.	21 NOV 0430	115	6.
20 NOV 0615	26	6.	20 NOV 1345	56	15.	20 NOV 2115	86	34.	21 NOV 0445	116	6.
20 NOV 0630	27	6.	20 NOV 1400	57	17.	20 NOV 2130	87	32.	21 NOV 0500	117	6.
20 NOV 0645	28	6.	20 NOV 1415	58	19.	20 NOV 2145	88	31.	21 NOV 0515	118	5.
20 NOV 0700	29	6.	20 NOV 1430	59	19.	20 NOV 2200	89	29.	21 NOV 0530	119	5.
20 NOV 0715	30	7.	20 NOV 1445	60	20.	20 NOV 2215	90	29.	21 NOV 0545	120	5.

```
  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     29.75-HR
+   (CFS)       (HR)
                          (CFS)
+      66.     18.50                  43.         21.         17.          17.
                        (INCHES)    1.758       3.383       3.469        3.469
                         (AC-FT)      21.         41.         42.          42.

                        CUMULATIVE AREA =     .23 SQ MI

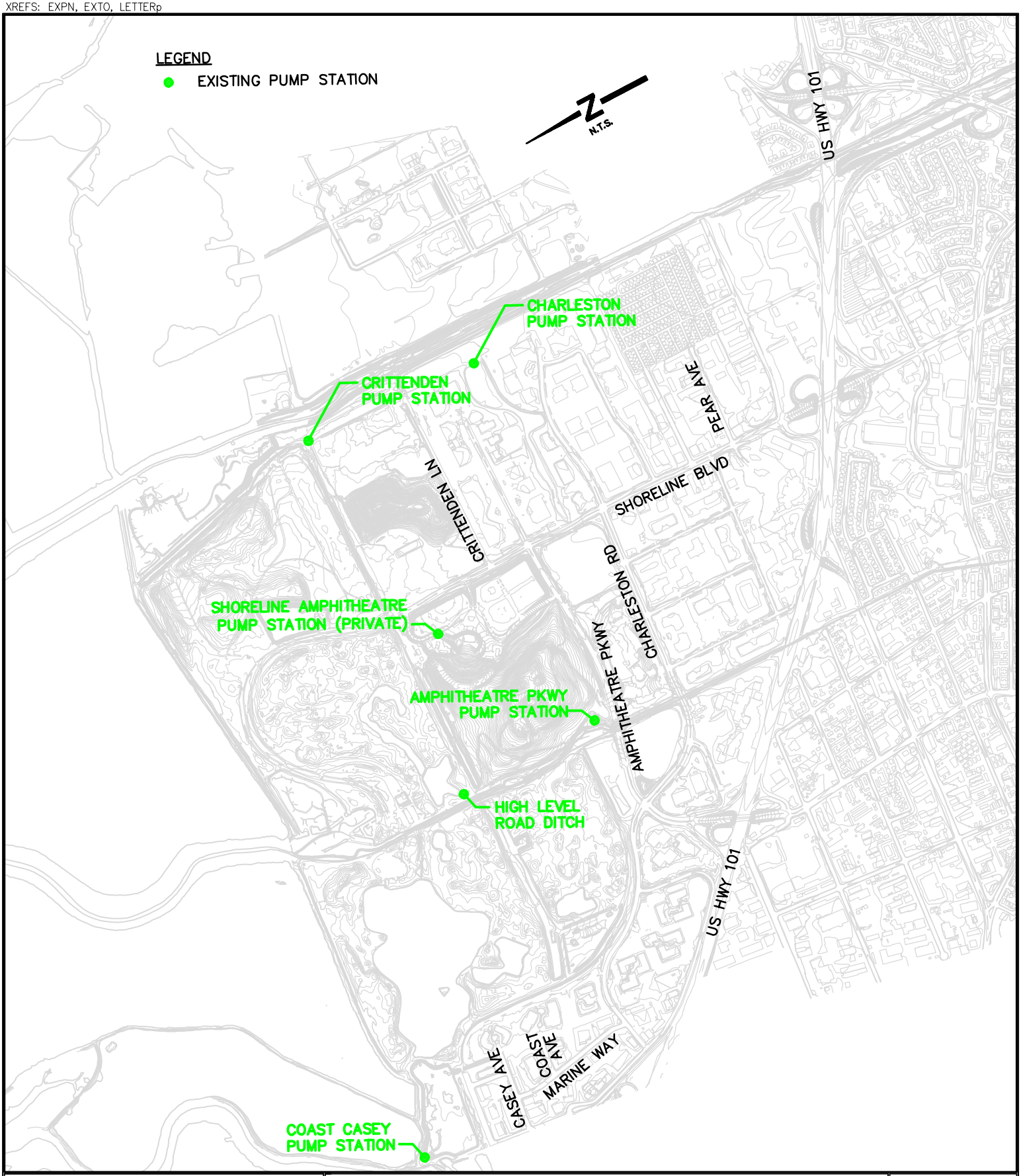
1
```

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	CHAR	6.	19.25	3.	1.	1.	.00		
+	HYDROGRAPH AT	STOR	32.	18.25	14.	7.	5.	.07		
+	HYDROGRAPH AT	OVER	40.	19.00	28.	13.	10.	.16		
+	3 COMBINED AT	TOTA	66.	18.50	43.	21.	17.	.23		

*** NORMAL END OF HEC-1 ***

TIME: 9:29 a.m. DATE: 07/19/05 PATH: N:\SJ0843\Cadd\Civil\
SERVER: SJS1 SERVICE: ENG DRAWING NAME: ET19-PUMPSTA.DWG
XREFS: EXPN, EXTO, LETTERp



NOLTE
BEYOND ENGINEERING

1731 NORTH FIRST STREET, SUITE A, SAN JOSE, CA. 95112
408.392.7200 TEL 408.392.0101 FAX WWW.NOLTE.COM

STORM DRAINAGE MASTER PLAN
PUMP STATION LOCATIONS

PREPARED FOR: CITY OF MOUNTAIN VIEW

SHEET NUMBER
FIG 6-1

JOB NUMBER
SJ084300

Station	Station Design Discharge	Number and Type of Pumps	Capactiy of Each Pump	Power Source	Design Return Period	Year Pumps/Electrical Last Replaced
Amphitheater Parkway		3-impeller cascade pumps, 700rpm 1 - Flygt sump pump 2hp, 1760rpm 1 - US MOTOR 25hp, 700rpm	GPM NOT LISTED	Deutz Diesel Engines 204hp US Motor 25hp		1995
Charleston	173Kgpm x2 3727gpm	3 - Byron-Jackson DH; Type D; LR22132	P1 - 17,300gpm P2 - 17,300gpm P3 - 3,727gpm	Caterpillar Engine 150hp/200rpm General Electric 50hp; 1185rpm 460V	100	1990
Coast Casey	79,500 gpm (180cfs) per pump?	3-36" axial flow (propeller type) Allis-Chalmers Series 15000 pumps. 2 submersibles:	Each Allis: 22,000gpm max.	2 Allis: Diesel 1Allis: Electric Submersibles: Electric	100	1995
Crittenden	50cfs per pump	4 - Peerless Pump Co. 1 - Sump, Peerless	50cfs & 10cfs 3cfs Jockey 450gpm #2,3,4 22,500gpm	4 - US Motors Titan Line	100	2000
High Level Road		2 - Flygt Pumps #3127 P1 #3152 P2	P1 - 400gpm P2 - 1100gpm	10hp & 25hp Electric		1994

Table 6-1: Pump Station Information

Charleston Pumpstation

Schaaf & Wheeler
CONSULTING CIVIL ENGINEERS

JOB NAME SCVWD.18.08-002
SHEET NO. ____ OF ____
CALCULATED BY EKC DATE 11/19/08
CHECKED BY ____ DATE ____
JOB NUMBER MISC. HAND CALCULATION

Charleston PS: - WEST

~~Drainage Area = 16739627.19 sf~~ 6539 / 5233.3

~~Pervious Area = 10% = 1673962.71 sf → C = 0.20~~
~~Roof Area = 40% = 6695849.66 sf → C = 0.85~~
~~Paved Area = 50% = 8369812.07 sf → C = 0.80~~

~~$\bar{C} = 0.1(0.2) + 0.4(0.85) + 0.5(0.8) = 0.76$~~

~~$\boxed{\bar{C} = 0.76}$~~ grass C =

~~i = 0.1758 in/hr (using equation from Hydrology manual~~

~~setup~~
grass C = .2
roof C = .85
pavd C = .8

A_1 = 9.143 Ac — 15% grass/dirt, 50% paved, 35% roof
A_2 = 1.670 Ac — 40% grass/dirt, 60% paved
A_3 = 1.169 Ac — 50% grass/dirt, 50% paved
A_4 = 0.971 Ac — 35% grass/dirt, 65% paved
A_5 = 22.294 Ac — 25% grass/dirt, 40% paved, 35% roof
A_6 = 1.989 Ac — 12% grass, 20% roof, 68% paved
A_7 = 9.650 Ac — 25% grass, 30% roof, 45% paved
A_8 = 8.859 Ac — 30% grass, 30% roof, 40% paved
A_9 = 1.593 Ac — 30% grass, 70% paved
A_{10} = 88.533 Ac — 35% grass, 35% paved, 30% roof
A_{11} = 1.163 Ac — 50% grass, 50% paved

$\bar{C}_1 = .15(0.95) + .5(0.85) + 0.35(0.90) = 0.81$ ✓
$\bar{C}_2 = 0.40(0.95) + 0.6(0.85) = 0.69$ ✓
$\bar{C}_3 = 0.5(0.95) + 0.5(0.85) = 0.65$ ✓
$\bar{C}_4 = 0.35(0.95) + 0.65(0.85) = 0.71$ ✓
$\bar{C}_5 = 0.25(0.95) + 0.40(0.85) + 0.35(0.90) = 0.77$ ✓
$\bar{C}_6 = 0.12(0.95) + 0.20(0.90) + 0.68(0.85) = 0.81$ ✓
$\bar{C}_7 = 0.25(0.95) + 0.30(0.90) + 0.45(0.85) = 0.77$ ✓
$\bar{C}_8 = 0.30(0.95) + 0.30(0.90) + 0.40(0.85) = 0.75$ ✓
$\bar{C}_9 = 0.30(0.95) + 0.70(0.85) = 0.73$ ✓
$\bar{C}_{10} = 0.35(0.95) + 0.35(0.85) + 0.30(0.90) = 0.73$ ✓
$\bar{C}_{11} = 0.5(0.95) + 0.5(0.85) = 0.65$ ✓

(over)

Schaaf & Wheeler
CONSULTING CIVIL ENGINEERS

JOB NAME: SCVW. Stevens Crk
SHEET NO. ____ OF ____
CALCULATED BY: EKC DATE: 11/19/08
CHECKED BY: ____ DATE: ____
JOB NUMBER: ____

STEVENS CREEK - INTERIOR DRAINAGE
SOUTHEAST OUTFALL

roof C = .90
paved C = .85
grass C = .45

A_1 = 12.563 Ac 5% lawn, 45% roof, 50% paved
A_2 = 10.554 Ac 10% lawn, 50% paved, 40% roof
A_3 = 4.806 Ac 10% lawn, 50% paved, 40% roof
A_4 = 13.848 Ac 20% lawn, 45% paved, 35% roof
A_5 = 13.378 Ac 30% lawn, 50% paved, 20% roof

$\bar{C}_1 = .05(0.45) + 0.5(0.85) + 0.45(.90) = 0.85$
$\bar{C}_2 = 0.1(0.45) + 0.5(0.90) + 0.4(0.85) = 0.84$
$\bar{C}_3 = 0.1(0.45) + 0.5(0.90) + 0.4(0.85) = 0.84$
$\bar{C}_4 = 0.2(0.45) + 0.45(0.90) + 0.35(0.85) = 0.79$
$\bar{C}_5 = 0.3(0.45) + 0.5(0.90) + 0.20(0.85) = 0.76$

% impervious = 83.8%
% pervious = 16.2%

total area = 55.149 Ac
T_c = 0.22 hrs

NORTHEAST TO CHARLESTON PS

Overland flow
Using Santa Clara Co. Drainage Manual - A-1
Slope = 0.20%
V = 0.90 ft/s (from Figure A-1) ⇒ using paved area
L = 3556.76 (flow length)
$t_c = L/V = 3556.76 \text{ ft} / 0.9 \text{ ft/s} = 3951.96 \text{ s}$
t_c = 65.87 min = 1.10 hrs

% impervious = 80%
% pervious = 20%

total Area = ~~169.27 Ac = 0.264 sq. mi~~
192.60 Ac = 0.301 sq. mi

Schaaf & Wheeler
CONSULTING CIVIL ENGINEERS

JOB NAME
SHEET NO. OF
CALCULATED BY DATE
CHECKED BY DATE
JOB NUMBER

Stevens Creek Interior Drainage - Hydrograph Routing

West Storm Drain

$T_c = 0.36$ hr

$\frac{R}{T_c + R} = 0.4$

$R =$

$R = 0.4R + .144$

$0.6R = 0.144$

$R = 0.24$

SCS CN = ~~82~~ 89 (Table C3 SCWD)

~~pitot channel~~

Southeast SD:

$\frac{R}{0.22 + R} = 0.4$

12798 - 12694

$R = 0.088 + 0.4R$

$R = 0.147$

Northeast:

$\frac{R}{1.1 + R} = 0.4$

8439 - 14323

$R = 0.44 + 0.4R$

$R = 0.733$

Precipitation Depth (PB card)

For calibration

$X_{T,D} = A_{T,D} + (B_{T,D} MAP)$ (SCC Drainage Manual)

T = return period = 100 yrs

D = duration = 24 hrs

A = 0.814046 } (From SCC Drainage Manual)

B = 0.243391 }

MAP = 31 in

$X_{T,D} = 8.36$ in.

FOR HYDROGRAPHS: MAP = 14 in

$X_{T,D} = 4.22$ in.

SCUW.08.08 - 002

Schaaf & Wheeler
CONSULTING CIVIL ENGINEERS

JOB NAME: CRITTENDEN SD Calcs
SHEET NO. ____ OF ____
CALCULATED BY: GVC DATE: 12/9/08
CHECKED BY ____ DATE ____
JOB NUMBER ____

New Area for N. Charleston PS = ~~249.45 Ac = 0.38 sq miles~~
192.60 Ac = 0.301 sq mi

Drainage Areas for Crittenden PS

A_1 = 5.225 Ac, 20% paved 80% grass → Goes to node 1
A_2 = 1.146 Ac, 20% paved 80% grass → goes to node 2
A_3 = 1.226 Ac, 5% paved, 95% grass } → go to node 3
A_4 = 12.694 Ac, 20% buildings, 25% grass, 55% paved }
A_5 = 3.573 Ac, 100% grass → goes to node 4
A_6 = 7.315 Ac, 55% paved, 45% grass → goes to node 5
A_7 = 8.329, 65% paved, 20% roof, 15% grass } → goes to node 6
A_8 = 3.477, 100% paved }
A_9 = 101.908, 95% grass, 5% paved → goes straight to PS

C_1 = 0.8(0.45) + 0.2(0.85) = 0.53
C_2 = 0.8(0.45) + 0.2(0.85) = 0.53
C_3 = 0.95(0.45) + 0.05(0.85) = 0.47
C_4 = 0.25(0.45) + 0.55(0.85) + 0.2(0.90) = 0.76 } 0.73
C_5 = 0.45
C_6 = 0.45(0.45) + 0.55(0.85) = 0.67
C_7 = 0.15(0.45) + 0.65(0.85) + 0.2(0.90) = 0.80 } 0.81
C_8 = 0.85
C_9 = 0.95(0.45) + 0.05(0.85) = 0.47

Combined to node 3: A = 1.226 + 12.694 = 13.92 Ac

$$C = \frac{0.47(1.226) + 0.76(12.694)}{13.92} = 0.73$$

Combined to node 6: A = 8.329 + 3.477 = 11.806 Ac

$$C = \frac{0.80(8.329) + 0.85(3.477)}{11.806} = 0.81$$

Tc = 26.91 min = 0.44 hrs
Total Area for SD = 42.985 Ac → 0.067 mi²
% Impervious = 59.2%

SCUW. 18.08-002

Schaaf & Wheeler
CONSULTING CIVIL ENGINEERS

JOB NAME CRITTENDEN
SHEET NO. ____ OF ____
CALCULATED BY EKE DATE 12/4/08
CHECKED BY ____ DATE ____
JOB NUMBER ____

Overland Flow To CRITTENDEN PS

A_d = 101,908 A_c = 0.159 sqmi Using Santa Clara Co. Drainage Manual A-1

Slope = 0.20%

V = 0.4 ft/s (from Figure A-1) = using Short grass pasture)

L = 3168.07 ft (flow length)

tc = L/V = 7920.18 s = 132 min = 2.20 hrs

% Impervious = 5%

$\frac{R}{Tc+R} = 0.4$

STORM DRAIN:

Tc = 38.89 min → 0.648 hr

$\frac{R}{0.490+R} = 0.4$

R = 0.196 + 0.4R

(R = 0.293)

SCS CN = 89 (Table C.3 SCVWD)

OVERLAND:

$\frac{R}{2.2+R} = 0.4$

R = 0.88 + 0.4R

(R = 1.467)

SCS CN = 89 (Table C.3 SCVWD)

Max flow from sum of Overland and SD Hydrographs: 43 cfs

Pump Station Capacity = 4 - 50 cfs pumps

plenty of capacity

Appendix D

Hydrologic Calibration

FEMA LOMR for Matadero and Barron Creeks Remediation Project
(Approved Calibration Model)

Flood Frequency Curve for San Francisquito Creek

Calibration Run for AMC

Federal Emergency Management Agency

Washington, D.C. 20472

OCT 26 2006

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

The Honorable Judy Kleinberg
Mayor, City of Palo Alto
P.O. Box 10250
Palo Alto, CA 94303

IN REPLY REFER TO:
Case No.: 06-09-BD65X
Community Name: City of Palo Alto, CA
Community No.: 060348
Effective Date of This Revision: OCT 26 2006

Dear Mayor Kleinberg:

The Flood Insurance Rate Maps for your community have been revised by this Letter of Map Revision (LOMR). Please use the enclosed annotated map panel(s) revised by this LOMR for floodplain management purposes and for all flood insurance policies and renewals issued in your community.

Additional documents are enclosed which provide information regarding this LOMR. Please see the List of Enclosures below to determine which documents are included. Other attachments specific to this request may be included as referenced in the Determination Document. If you have any questions regarding floodplain management regulations for your community or the National Flood Insurance Program (NFIP) in general, please contact the Consultation Coordination Officer for your community. If you have any technical questions regarding this LOMR, please contact the Director, Federal Insurance and Mitigation Division of the Department of Homeland Security's Federal Emergency Management Agency (FEMA) in Oakland, California, at (510) 627-7175, or the FEMA Map Assistance Center, toll free, at 1-877-336-2627 (1-877-FEMA MAP). Additional information about the NFIP is available on our website at http://www.fema.gov/nfip.

Sincerely,

Kevin C. Long

Kevin C. Long, CFM, Project Engineer
Engineering Management Section
Mitigation Division

For: William R. Blanton Jr., CFM, Chief
Engineering Management Section
Mitigation Division

List of Enclosures:

Letter of Map Revision Determination Document
Annotated Flood Insurance Rate Map

cc: Mr. Saeid Hosseini
Senior Project Manager
Santa Clara Valley Water District

[redacted]

Mark Thomas & Co., Inc.

[redacted]

 | Issue Date: OCT 2 6 2006 | Effective Date: OCT 2 6 2006 | Case No.: 06-09-BD65X | LOMR-APP

Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION DETERMINATION DOCUMENT

COMMUNITY AND REVISION INFORMATION		PROJECT DESCRIPTION	BASIS OF REQUEST
COMMUNITY	City of Palo Alto Santa Clara County California	NO PROJECT	MAP UPDATE
	COMMUNITY NO.: 060348		
IDENTIFIER	Matadero/Barron Creek Remediation Project	APPROXIMATE LATITUDE & LONGITUDE: 37.400, -122.100 SOURCE: Other DATUM: NAD 83	

ANNOTATED MAPPING ENCLOSURES	ANNOTATED STUDY ENCLOSURES
TYPE: FIRM* NO.: 060348 0005 E DATE: June 2, 1999	NO REVISION TO THE FLOOD INSURANCE STUDY REPORT

Enclosures reflect changes to flooding sources affected by this revision.
* FIRM - Flood Insurance Rate Map; ** FBFM - Flood Boundary and Floodway Map; *** FHBM - Flood Hazard Boundary Map

FLOODING SOURCE(S) & REVISED REACH(ES)

Matadero Creek - from Bayshore Freeway to Foothill Expressway
Barron Creek - from Louis Road to Foothill Expressway
San Francisco Bay - from Greer Road to Ross Road

SUMMARY OF REVISIONS

This Letter of Map Revision (LOMR) is an update of a LOMR dated June 23, 2006 (Case No. 06-09-A606P). The June 23 LOMR revised the Special Flood Hazard Areas (SFHAs), the areas that would be inundated by the base (1-percent-annual-chance) flood, and BFEs along Barron Creek and Matadero Creek. This LOMR updates the June 23 LOMR based on an updated zone designation shown on the FIRM Panel No. 060348 0005 E for the City of Palo Alto, Santa Clara County, California, dated June 2, 1999. This LOMR rescinds Panel No. 060348 0003 E included with the June 23 LOMR. A copy of the updated FIRM Panel No. 060348 0005 E is included with this LOMR and will become effective as of the date of this letter. In addition, FIS Profiles 04P, 05P, and 06P provided in the June 23 LOMR will become effective October 25, 2006; however, they will not be included with this LOMR.

* BFEs - Base Flood Elevations

DETERMINATION

This document provides the determination from the Department of Homeland Security's Federal Emergency Management Agency (FEMA) regarding a request for a LOMR for the area described above. Using the information submitted, we have determined that a revision to the flood hazards depicted in the Flood Insurance Study (FIS) report and/or National Flood Insurance Program (NFIP) map is warranted. This document revises the effective NFIP map, as indicated in the attached documentation. Please use the enclosed annotated map panels revised by this LOMR for floodplain management purposes and for all flood insurance policies and renewals in your community.

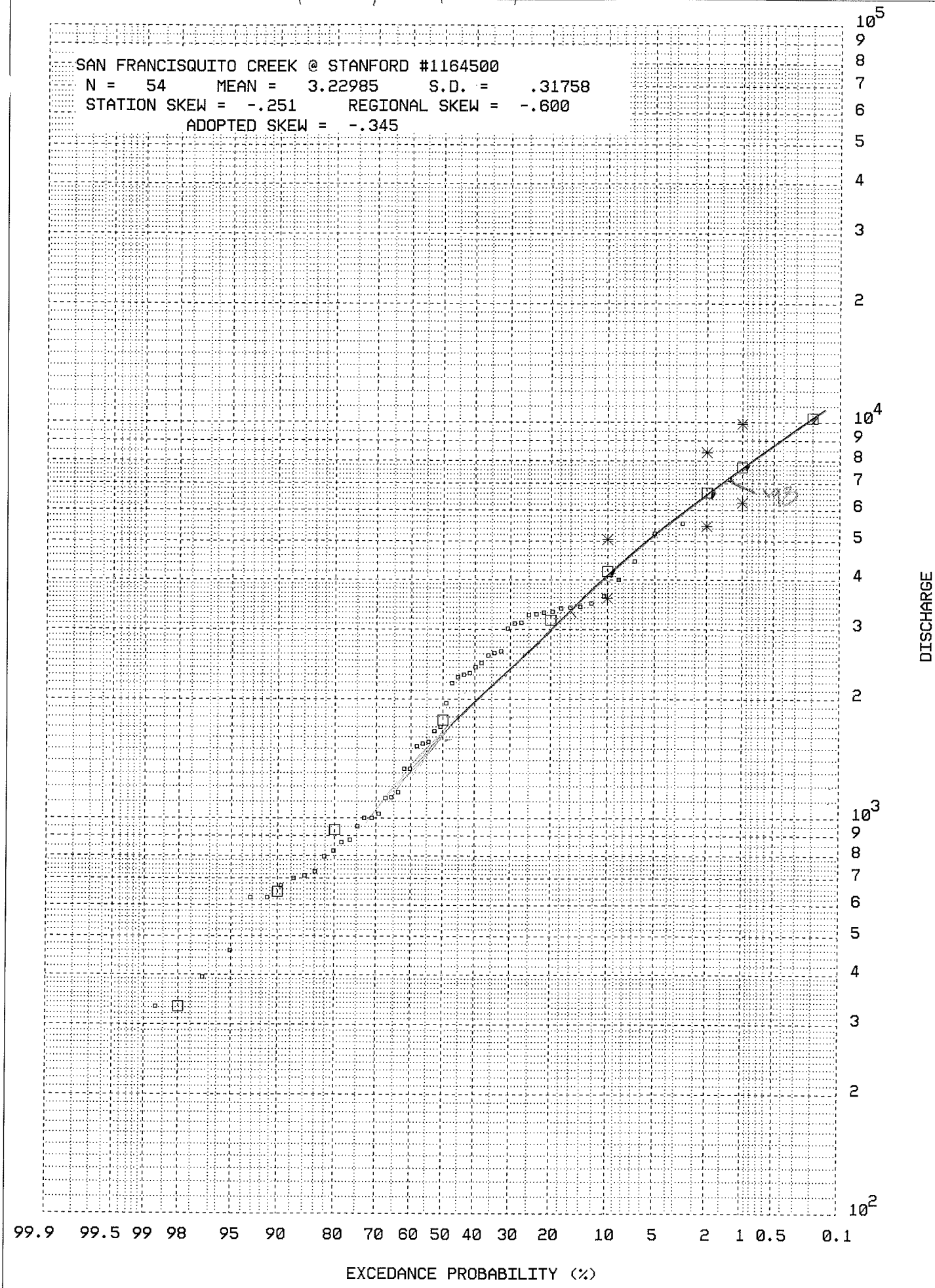
This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.

Kevin C. Long

Kevin C. Long, CFM, Project Engineer
Engineering Management Section
Mitigation Division

106979 10.3.1.0609BDBD65 102-D

Outliers '39, '57, '61, '76, '77



CALIBRATION OF AMC TO SAN FRANCISQUITO CREEK FLOOD FREQUENCY ANALYSIS USING STATISTICALLY BALANCED PRECIPITATION PATTERN.

```
1****************************************                                                    ****************************************
 *                                      *                                                    *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                                    *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998              *                                                    *    HYDROLOGIC ENGINEERING CENTER     *
 *            VERSION 4.1               *                                                    *          609 SECOND STREET           *
 *                                      *                                                    *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   06JAN09  TIME  14:26:29  *                                                    *           (916) 756-1104             *
 *                                      *                                                    *                                      *
 ****************************************                                                    ****************************************
```

```
X     X  XXXXXXX   XXXXX           X
X     X  X        X     X         XX
X     X  X        X                X
XXXXXXX  XXXX     X        XXXXX   X
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX          XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  1           ID   SAN FRANCISQUITO CREEK
  2           ID   24 hour STORM - 15 MINUTE PATTERN
  3           ID   CALIBRATE AMC
  4           ID   SCHAAF & WHEELER    12/16/08
  5           IT      15  1JUN99    0000     300
  6           IN      15  1JUN99    0000
  7           IO       1       0
              *  BEGINNING OF STREAM NETWORK DATA

  8           KK     SF1
  9           BA    37.0     31.
 10           PB    8.36          (24-hour 100-year; MAP=31")
              *  1976 FIS STORM DISTRIBUTION BALANCED TO LOCAL STATISTICS
 11           PI    0.31    0.35    0.35    0.42    0.45    0.52    0.39    0.63    0.39    0.46
 12           PI    0.48    0.52    0.65    0.74    0.78    0.82    0.88    0.92    0.94    0.98
 13           PI    0.92    0.83    0.78    0.75    0.73    0.71    0.71    0.70    0.98    0.78
 14           PI    0.74    0.78    0.84    0.74    0.74    0.96    0.70    0.74    0.74    0.82
 15           PI    0.92    0.57    0.74    0.77    0.80    0.82    0.83    0.83    0.84    0.85
 16           PI    0.86    0.88    1.03    1.72    1.78    1.90    1.13    1.25    1.31    1.38
 17           PI    1.40    1.55    1.78    2.15    1.89    1.46    2.01    2.22    7.62    2.66
 18           PI    2.18    2.17    1.39    1.19    1.43    1.56    1.65    0.78    0.92    0.85
 19           PI    0.85    0.83    0.83    0.78    0.79    0.78    0.70    0.72    0.89    0.78
 20           PI    0.74    0.72    0.71    0.70    0.65    0.79
 21           LS       0      60       5
              *  Unit Hydrograph using SF District COE S-Graph (Basin n=.08)
 22           UI   314.8   543.1   896.8  1665.7  2072.2  2981.6  3610.3  4086.3  4269.0  4255.3
 23           UI  4216.9  4084.0  3997.7  3741.8  3489.7  3266.6  2554.1  2367.2  2090.6  1830.1
 24           UI  1709.4  1591.7  1545.0  1496.7  1412.7  1375.4  1306.7  1247.1  1212.1  1128.5
 25           UI  1093.5  1051.3   724.7   665.2   665.2   665.2   665.2   665.2   665.2   665.2
 26           UI   665.2   665.2   665.2   665.2   665.2   665.2   665.2   665.2   446.1   380.1
 27           UI   380.1   380.1   380.1   380.1   380.1   380.1   380.1   380.1   380.1   380.1
 28           UI   380.1   380.1   380.1   380.1   277.4   231.6   231.6   231.6   231.6   231.6
 29           UI   231.6   231.6   231.6   231.6   231.6   231.6   231.6   231.6   231.6   231.6
 30           UI   158.6   112.9   112.8   112.9   112.8   112.9   112.8   112.9   112.8   112.9
 31           UI   112.8   112.9   112.8   112.9   112.8   112.9    68.2    29.7    29.7    29.7
 32           UI    29.7    29.7    29.7    29.7    29.7    29.7    29.7    29.7    29.7    29.7
 33           UI    29.7    29.7    16.0      .0      .0      .0      .0
 34           ZZ
```

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1****************************************                                                    ****************************************
 *                                      *                                                    *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                                    *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998              *                                                    *    HYDROLOGIC ENGINEERING CENTER     *
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 *  RUN DATE   06JAN09  TIME  14:26:29  *                                                    *           (916) 756-1104             *
 *                                      *                                                    *                                      *
 ****************************************                                                    ****************************************


                          SAN FRANCISQUITO CREEK
                          24 hour STORM - 15 MINUTE PATTERN
                          CALIBRATE AMC
                          SCHAAF & WHEELER    12/16/08

   7 IO          OUTPUT CONTROL VARIABLES
                       IPRNT           1  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                        NMIN          15  MINUTES IN COMPUTATION INTERVAL
                       IDATE      1JUN99  STARTING DATE
                       ITIME        0000  STARTING TIME
                          NQ         300  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE      4JUN99  ENDING DATE
                      NDTIME        0245  ENDING TIME
                      ICENT          19  CENTURY MARK

                  COMPUTATION INTERVAL     .25 HOURS
                       TOTAL TIME BASE   74.75 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   8 KK     *       SF1  *
            *            *
            **************

   6 IN          TIME DATA FOR INPUT TIME SERIES
                       JXMIN          15  TIME INTERVAL IN MINUTES
                      JXDATE      1JUN99  STARTING DATE
                      JXTIME           0  STARTING TIME

               SUBBASIN RUNOFF DATA

   9 BA          SUBBASIN CHARACTERISTICS
                       TAREA       37.00  SUBBASIN AREA
                        SNAP       31.00  NORMAL ANNUAL PRECIPITATION
                       RATIO         .00  RATIO OF HYDROGRAPH

                 PRECIPITATION DATA

  10 PB                STORM        8.36  BASIN TOTAL PRECIPITATION

  11 PI            INCREMENTAL PRECIPITATION PATTERN
                       .31       .35       .35       .42       .45       .52       .39       .63       .39       .46
                       .48       .52       .65       .74       .78       .82       .88       .92       .94       .98
                       .92       .83       .78       .75       .73       .71       .71       .70       .98       .78
                       .74       .78       .84       .74       .74       .96       .70       .74       .74       .82
                       .92       .57       .74       .77       .80       .82       .83       .83       .84       .85
                       .86       .88      1.03      1.72      1.78      1.90      1.13      1.25      1.31      1.38
                      1.40      1.55      1.78      2.15      1.89      1.46      2.01      2.22      7.62      2.66
                      2.18      2.17      1.39      1.19      1.43      1.56      1.65       .78       .92       .85
                       .85       .83       .83       .78       .79       .78       .70       .72       .89       .78
                       .74       .72       .71       .70       .65       .79

  21 LS          SCS LOSS RATE
                       STRTL        1.33  INITIAL ABSTRACTION
                      CRVNBR       60.00  CURVE NUMBER
                       RTIMP        5.00  PERCENT IMPERVIOUS AREA

  22 UI          INPUT UNITGRAPH, 113 ORDINATES,  VOLUME = 1.00
                     314.8     543.1     896.8    1665.7    2072.2    2981.6    3610.3    4086.3    4269.0    4255.3
                    4216.9    4084.0    3997.7    3741.8    3489.7    3266.6    2554.1    2367.2    2090.6    1830.1
                    1709.4    1591.7    1545.0    1496.7    1412.7    1375.4    1306.7    1247.1    1212.1    1128.5
                    1093.5    1051.3     724.7     665.2     665.2     665.2     665.2     665.2     665.2     665.2
                     665.2     665.2     665.2     665.2     665.2     665.2     665.2     665.2     446.1     380.1
                     380.1     380.1     380.1     380.1     380.1     380.1     380.1     380.1     380.1     380.1
                     380.1     380.1     380.1     380.1     277.4     231.6     231.6     231.6     231.6     231.6
                     231.6     231.6     231.6     231.6     231.6     231.6     231.6     231.6     231.6     231.6
                     158.6     112.9     112.8     112.9     112.8     112.9     112.8     112.9     112.8     112.9
```

112.8	112.9	112.8	112.9	112.8	112.9	68.2	29.7	29.7	29.7
29.7	29.7	29.7	29.7	29.7	29.7	29.7	29.7	29.7	29.7
29.7	29.7	16.0							

***

HYDROGRAPH AT STATION SF1

DA MON HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q	DA MON HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q
1 JUN 0000	1	.00	.00	.00	0.	2 JUN 1330	151	.00	.00	.00	650.
1 JUN 0015	2	.03	.02	.00	0.	2 JUN 1345	152	.00	.00	.00	622.
1 JUN 0030	3	.03	.03	.00	1.	2 JUN 1400	153	.00	.00	.00	594.
1 JUN 0045	4	.03	.03	.00	2.	2 JUN 1415	154	.00	.00	.00	568.
1 JUN 0100	5	.04	.03	.00	5.	2 JUN 1430	155	.00	.00	.00	547.
1 JUN 0115	6	.04	.04	.00	8.	2 JUN 1445	156	.00	.00	.00	526.
1 JUN 0130	7	.04	.04	.00	13.	2 JUN 1500	157	.00	.00	.00	503.
1 JUN 0145	8	.03	.03	.00	18.	2 JUN 1515	158	.00	.00	.00	479.
1 JUN 0200	9	.05	.05	.00	25.	2 JUN 1530	159	.00	.00	.00	458.
1 JUN 0215	10	.03	.03	.00	33.	2 JUN 1545	160	.00	.00	.00	438.
1 JUN 0230	11	.04	.04	.00	41.	2 JUN 1600	161	.00	.00	.00	416.
1 JUN 0245	12	.04	.04	.00	49.	2 JUN 1615	162	.00	.00	.00	399.
1 JUN 0300	13	.04	.04	.00	57.	2 JUN 1630	163	.00	.00	.00	385.
1 JUN 0315	14	.05	.05	.00	66.	2 JUN 1645	164	.00	.00	.00	371.
1 JUN 0330	15	.06	.06	.00	74.	2 JUN 1700	165	.00	.00	.00	355.
1 JUN 0345	16	.07	.06	.00	82.	2 JUN 1715	166	.00	.00	.00	325.
1 JUN 0400	17	.07	.07	.00	91.	2 JUN 1730	167	.00	.00	.00	295.
1 JUN 0415	18	.07	.07	.00	100.	2 JUN 1745	168	.00	.00	.00	276.
1 JUN 0430	19	.08	.07	.00	109.	2 JUN 1800	169	.00	.00	.00	259.
1 JUN 0445	20	.08	.07	.00	118.	2 JUN 1815	170	.00	.00	.00	242.
1 JUN 0500	21	.08	.08	.00	128.	2 JUN 1830	171	.00	.00	.00	228.
1 JUN 0515	22	.08	.07	.00	139.	2 JUN 1845	172	.00	.00	.00	214.
1 JUN 0530	23	.07	.07	.00	149.	2 JUN 1900	173	.00	.00	.00	200.
1 JUN 0545	24	.07	.06	.00	160.	2 JUN 1915	174	.00	.00	.00	184.
1 JUN 0600	25	.06	.06	.00	170.	2 JUN 1930	175	.00	.00	.00	171.
1 JUN 0615	26	.06	.06	.00	180.	2 JUN 1945	176	.00	.00	.00	159.
1 JUN 0630	27	.06	.06	.00	190.	2 JUN 2000	177	.00	.00	.00	146.
1 JUN 0645	28	.06	.05	.00	198.	2 JUN 2015	178	.00	.00	.00	137.
1 JUN 0700	29	.06	.05	.01	206.	2 JUN 2030	179	.00	.00	.00	130.
1 JUN 0715	30	.08	.07	.01	215.	2 JUN 2045	180	.00	.00	.00	123.
1 JUN 0730	31	.07	.06	.01	225.	2 JUN 2100	181	.00	.00	.00	116.
1 JUN 0745	32	.06	.05	.01	237.	2 JUN 2115	182	.00	.00	.00	104.
1 JUN 0800	33	.07	.05	.01	253.	2 JUN 2130	183	.00	.00	.00	92.
1 JUN 0815	34	.07	.06	.01	271.	2 JUN 2145	184	.00	.00	.00	84.
1 JUN 0830	35	.06	.05	.01	295.	2 JUN 2200	185	.00	.00	.00	76.
1 JUN 0845	36	.06	.05	.01	323.	2 JUN 2215	186	.00	.00	.00	69.
1 JUN 0900	37	.08	.06	.02	356.	2 JUN 2230	187	.00	.00	.00	62.
1 JUN 0915	38	.06	.04	.01	392.	2 JUN 2245	188	.00	.00	.00	56.
1 JUN 0930	39	.06	.05	.02	432.	2 JUN 2300	189	.00	.00	.00	49.
1 JUN 0945	40	.06	.05	.02	477.	2 JUN 2315	190	.00	.00	.00	43.
1 JUN 1000	41	.07	.05	.02	523.	2 JUN 2330	191	.00	.00	.00	36.
1 JUN 1015	42	.08	.05	.02	576.	2 JUN 2345	192	.00	.00	.00	31.
1 JUN 1030	43	.05	.03	.01	627.	3 JUN 0000	193	.00	.00	.00	26.
1 JUN 1045	44	.06	.04	.02	680.	3 JUN 0015	194	.00	.00	.00	22.
1 JUN 1100	45	.06	.04	.02	735.	3 JUN 0030	195	.00	.00	.00	21.
1 JUN 1115	46	.07	.04	.02	786.	3 JUN 0045	196	.00	.00	.00	19.
1 JUN 1130	47	.07	.05	.02	843.	3 JUN 0100	197	.00	.00	.00	18.
1 JUN 1145	48	.07	.05	.02	897.	3 JUN 0115	198	.00	.00	.00	16.
1 JUN 1200	49	.07	.04	.03	952.	3 JUN 0130	199	.00	.00	.00	15.
1 JUN 1215	50	.07	.04	.03	1008.	3 JUN 0145	200	.00	.00	.00	13.
1 JUN 1230	51	.07	.04	.03	1067.	3 JUN 0200	201	.00	.00	.00	12.
1 JUN 1245	52	.07	.04	.03	1129.	3 JUN 0215	202	.00	.00	.00	11.
1 JUN 1300	53	.07	.04	.03	1191.	3 JUN 0230	203	.00	.00	.00	9.
1 JUN 1315	54	.09	.05	.04	1260.	3 JUN 0245	204	.00	.00	.00	8.
1 JUN 1330	55	.14	.08	.06	1338.	3 JUN 0300	205	.00	.00	.00	6.
1 JUN 1345	56	.15	.08	.07	1428.	3 JUN 0315	206	.00	.00	.00	5.
1 JUN 1400	57	.16	.08	.07	1535.	3 JUN 0330	207	.00	.00	.00	3.
1 JUN 1415	58	.09	.05	.05	1658.	3 JUN 0345	208	.00	.00	.00	2.
1 JUN 1430	59	.10	.05	.05	1802.	3 JUN 0400	209	.00	.00	.00	1.
1 JUN 1445	60	.11	.05	.06	1968.	3 JUN 0415	210	.00	.00	.00	0.
1 JUN 1500	61	.12	.06	.06	2140.	3 JUN 0430	211	.00	.00	.00	0.
1 JUN 1515	62	.12	.06	.06	2328.	3 JUN 0445	212	.00	.00	.00	0.
1 JUN 1530	63	.13	.06	.07	2507.	3 JUN 0500	213	.00	.00	.00	0.
1 JUN 1545	64	.15	.07	.08	2686.	3 JUN 0515	214	.00	.00	.00	0.
1 JUN 1600	65	.18	.08	.10	2869.	3 JUN 0530	215	.00	.00	.00	0.
1 JUN 1615	66	.16	.07	.09	3060.	3 JUN 0545	216	.00	.00	.00	0.
1 JUN 1630	67	.12	.05	.07	3263.	3 JUN 0600	217	.00	.00	.00	0.
1 JUN 1645	68	.17	.07	.10	3488.	3 JUN 0615	218	.00	.00	.00	0.
1 JUN 1700	69	.19	.07	.11	3725.	3 JUN 0630	219	.00	.00	.00	0.
1 JUN 1715	70	.64	.22	.41	4067.	3 JUN 0645	220	.00	.00	.00	0.
1 JUN 1730	71	.22	.07	.15	4406.	3 JUN 0700	221	.00	.00	.00	0.
1 JUN 1745	72	.18	.06	.12	4783.	3 JUN 0715	222	.00	.00	.00	0.
1 JUN 1800	73	.18	.06	.13	5295.	3 JUN 0730	223	.00	.00	.00	0.
1 JUN 1815	74	.12	.03	.08	5725.	3 JUN 0745	224	.00	.00	.00	0.
1 JUN 1830	75	.10	.03	.07	6295.	3 JUN 0800	225	.00	.00	.00	0.
1 JUN 1845	76	.12	.03	.09	6792.	3 JUN 0815	226	.00	.00	.00	0.
1 JUN 1900	77	.13	.04	.09	7205.	3 JUN 0830	227	.00	.00	.00	0.
1 JUN 1915	78	.14	.04	.10	7501.	3 JUN 0845	228	.00	.00	.00	0.
1 JUN 1930	79	.07	.02	.05	7671.	3 JUN 0900	229	.00	.00	.00	0.
1 JUN 1945	80	.08	.02	.06	7780.	3 JUN 0915	230	.00	.00	.00	0.
1 JUN 2000	81	.07	.02	.05	7811.	3 JUN 0930	231	.00	.00	.00	0.
1 JUN 2015	82	.07	.02	.05	7810.	3 JUN 0945	232	.00	.00	.00	0.
1 JUN 2030	83	.07	.02	.05	7753.	3 JUN 1000	233	.00	.00	.00	0.
1 JUN 2045	84	.07	.02	.05	7628.	3 JUN 1015	234	.00	.00	.00	0.
1 JUN 2100	85	.07	.02	.05	7477.	3 JUN 1030	235	.00	.00	.00	0.
1 JUN 2115	86	.07	.02	.05	7151.	3 JUN 1045	236	.00	.00	.00	0.

1	JUN	2130	87	.07	.02	.05	6944.	*	3	JUN	1100	237	.00	.00	.00	0.
1	JUN	2145	88	.06	.01	.04	6718.	*	3	JUN	1115	238	.00	.00	.00	0.
1	JUN	2200	89	.06	.01	.05	6489.	*	3	JUN	1130	239	.00	.00	.00	0.
1	JUN	2215	90	.07	.02	.06	6337.	*	3	JUN	1145	240	.00	.00	.00	0.
1	JUN	2230	91	.07	.02	.05	6194.	*	3	JUN	1200	241	.00	.00	.00	0.
1	JUN	2245	92	.06	.01	.05	6078.	*	3	JUN	1215	242	.00	.00	.00	0.
1	JUN	2300	93	.06	.01	.05	5974.	*	3	JUN	1230	243	.00	.00	.00	0.
1	JUN	2315	94	.06	.01	.05	5858.	*	3	JUN	1245	244	.00	.00	.00	0.
1	JUN	2330	95	.06	.01	.05	5788.	*	3	JUN	1300	245	.00	.00	.00	0.
1	JUN	2345	96	.05	.01	.04	5703.	*	3	JUN	1315	246	.00	.00	.00	0.
2	JUN	0000	97	.07	.01	.05	5625.	*	3	JUN	1330	247	.00	.00	.00	0.
2	JUN	0015	98	.00	.00	.00	5549.	*	3	JUN	1345	248	.00	.00	.00	0.
2	JUN	0030	99	.00	.00	.00	5456.	*	3	JUN	1400	249	.00	.00	.00	0.
2	JUN	0045	100	.00	.00	.00	5361.	*	3	JUN	1415	250	.00	.00	.00	0.
2	JUN	0100	101	.00	.00	.00	5224.	*	3	JUN	1430	251	.00	.00	.00	0.
2	JUN	0115	102	.00	.00	.00	4989.	*	3	JUN	1445	252	.00	.00	.00	0.
2	JUN	0130	103	.00	.00	.00	4782.	*	3	JUN	1500	253	.00	.00	.00	0.
2	JUN	0145	104	.00	.00	.00	4573.	*	3	JUN	1515	254	.00	.00	.00	0.
2	JUN	0200	105	.00	.00	.00	4344.	*	3	JUN	1530	255	.00	.00	.00	0.
2	JUN	0215	106	.00	.00	.00	4123.	*	3	JUN	1545	256	.00	.00	.00	0.
2	JUN	0230	107	.00	.00	.00	3916.	*	3	JUN	1600	257	.00	.00	.00	0.
2	JUN	0245	108	.00	.00	.00	3709.	*	3	JUN	1615	258	.00	.00	.00	0.
2	JUN	0300	109	.00	.00	.00	3506.	*	3	JUN	1630	259	.00	.00	.00	0.
2	JUN	0315	110	.00	.00	.00	3306.	*	3	JUN	1645	260	.00	.00	.00	0.
2	JUN	0330	111	.00	.00	.00	3132.	*	3	JUN	1700	261	.00	.00	.00	0.
2	JUN	0345	112	.00	.00	.00	2971.	*	3	JUN	1715	262	.00	.00	.00	0.
2	JUN	0400	113	.00	.00	.00	2811.	*	3	JUN	1730	263	.00	.00	.00	0.
2	JUN	0415	114	.00	.00	.00	2688.	*	3	JUN	1745	264	.00	.00	.00	0.
2	JUN	0430	115	.00	.00	.00	2578.	*	3	JUN	1800	265	.00	.00	.00	0.
2	JUN	0445	116	.00	.00	.00	2475.	*	3	JUN	1815	266	.00	.00	.00	0.
2	JUN	0500	117	.00	.00	.00	2380.	*	3	JUN	1830	267	.00	.00	.00	0.
2	JUN	0515	118	.00	.00	.00	2225.	*	3	JUN	1845	268	.00	.00	.00	0.
2	JUN	0530	119	.00	.00	.00	2110.	*	3	JUN	1900	269	.00	.00	.00	0.
2	JUN	0545	120	.00	.00	.00	2020.	*	3	JUN	1915	270	.00	.00	.00	0.
2	JUN	0600	121	.00	.00	.00	1932.	*	3	JUN	1930	271	.00	.00	.00	0.
2	JUN	0615	122	.00	.00	.00	1858.	*	3	JUN	1945	272	.00	.00	.00	0.
2	JUN	0630	123	.00	.00	.00	1792.	*	3	JUN	2000	273	.00	.00	.00	0.
2	JUN	0645	124	.00	.00	.00	1728.	*	3	JUN	2015	274	.00	.00	.00	0.
2	JUN	0700	125	.00	.00	.00	1664.	*	3	JUN	2030	275	.00	.00	.00	0.
2	JUN	0715	126	.00	.00	.00	1598.	*	3	JUN	2045	276	.00	.00	.00	0.
2	JUN	0730	127	.00	.00	.00	1547.	*	3	JUN	2100	277	.00	.00	.00	0.
2	JUN	0745	128	.00	.00	.00	1497.	*	3	JUN	2115	278	.00	.00	.00	0.
2	JUN	0800	129	.00	.00	.00	1445.	*	3	JUN	2130	279	.00	.00	.00	0.
2	JUN	0815	130	.00	.00	.00	1409.	*	3	JUN	2145	280	.00	.00	.00	0.
2	JUN	0830	131	.00	.00	.00	1378.	*	3	JUN	2200	281	.00	.00	.00	0.
2	JUN	0845	132	.00	.00	.00	1345.	*	3	JUN	2215	282	.00	.00	.00	0.
2	JUN	0900	133	.00	.00	.00	1310.	*	3	JUN	2230	283	.00	.00	.00	0.
2	JUN	0915	134	.00	.00	.00	1243.	*	3	JUN	2245	284	.00	.00	.00	0.
2	JUN	0930	135	.00	.00	.00	1187.	*	3	JUN	2300	285	.00	.00	.00	0.
2	JUN	0945	136	.00	.00	.00	1145.	*	3	JUN	2315	286	.00	.00	.00	0.
2	JUN	1000	137	.00	.00	.00	1103.	*	3	JUN	2330	287	.00	.00	.00	0.
2	JUN	1015	138	.00	.00	.00	1065.	*	3	JUN	2345	288	.00	.00	.00	0.
2	JUN	1030	139	.00	.00	.00	1032.	*	4	JUN	0000	289	.00	.00	.00	0.
2	JUN	1045	140	.00	.00	.00	999.	*	4	JUN	0015	290	.00	.00	.00	0.
2	JUN	1100	141	.00	.00	.00	963.	*	4	JUN	0030	291	.00	.00	.00	0.
2	JUN	1115	142	.00	.00	.00	927.	*	4	JUN	0045	292	.00	.00	.00	0.
2	JUN	1130	143	.00	.00	.00	894.	*	4	JUN	0100	293	.00	.00	.00	0.
2	JUN	1145	144	.00	.00	.00	863.	*	4	JUN	0115	294	.00	.00	.00	0.
2	JUN	1200	145	.00	.00	.00	827.	*	4	JUN	0130	295	.00	.00	.00	0.
2	JUN	1215	146	.00	.00	.00	802.	*	4	JUN	0145	296	.00	.00	.00	0.
2	JUN	1230	147	.00	.00	.00	782.	*	4	JUN	0200	297	.00	.00	.00	0.
2	JUN	1245	148	.00	.00	.00	761.	*	4	JUN	0215	298	.00	.00	.00	0.
2	JUN	1300	149	.00	.00	.00	738.	*	4	JUN	0230	299	.00	.00	.00	0.
2	JUN	1315	150	.00	.00	.00	692.	*	4	JUN	0245	300	.00	.00	.00	0.
								*								

****

TOTAL RAINFALL = 8.36, TOTAL LOSS = 4.52, TOTAL EXCESS = 3.84

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	74.75-HR
+ (CFS)	(HR)					
		(CFS)				
+ 7811.	20.00		6759.	3536.	1274.	1227.
		(INCHES)	1.698	3.554	3.843	3.843
		(AC-FT)	3352.	7013.	7583.	7583.

CUMULATIVE AREA = 37.00 SQ MI

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	SF1	7811.	20.00	6759.	3536.	1274.	37.00		

*** NORMAL END OF HEC-1 ***

Appendix E

Interior Mapping

E.1 – Interior Basin Delineation

E.2 – Tidal Mapping (Photographic Base)

E.3 – Tidal Mapping (Topographic Base)

STEVENS CREEK
SUBBASIN AND SUB-SUBBASIN DELINEATION

FIGURE E.1

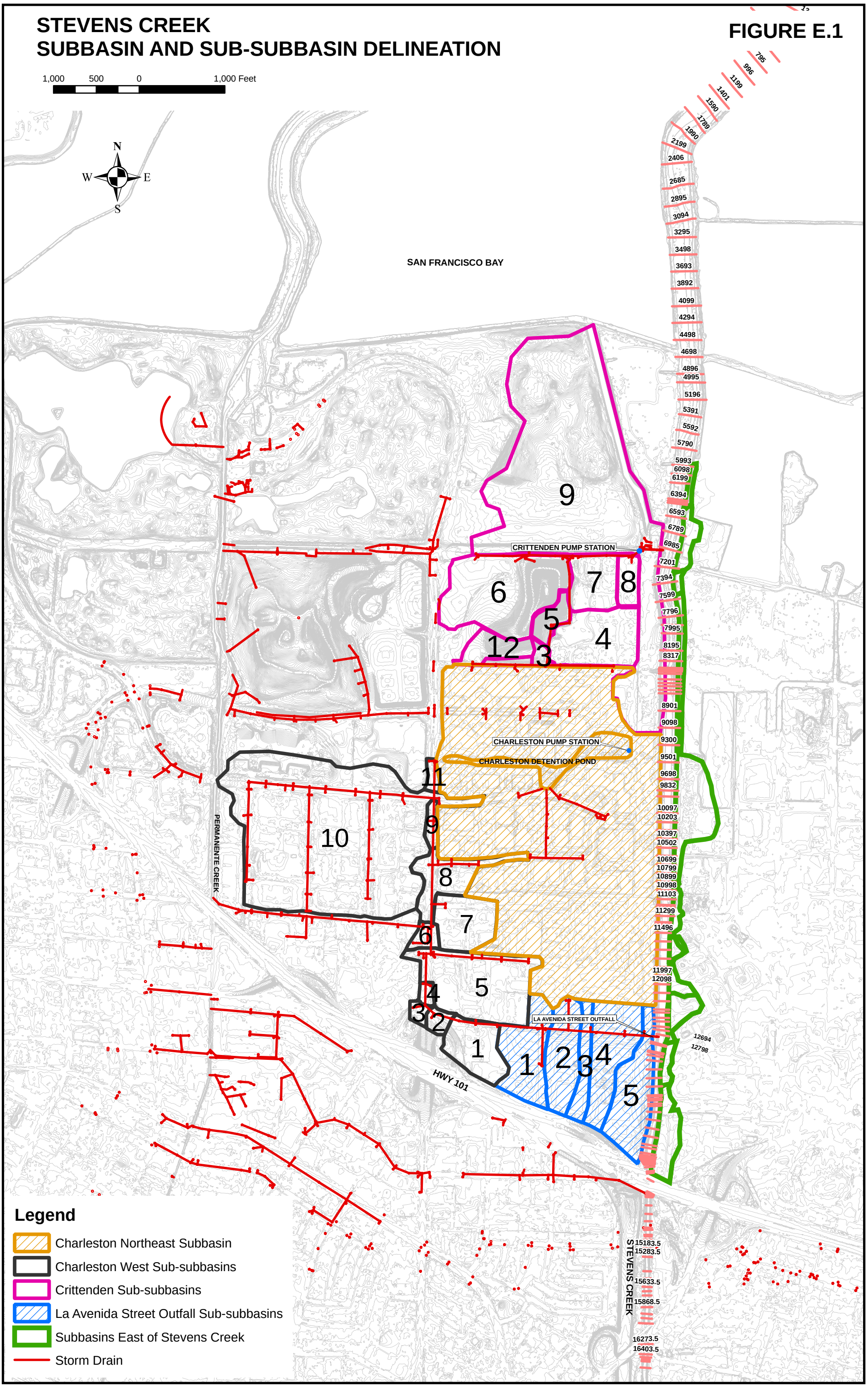
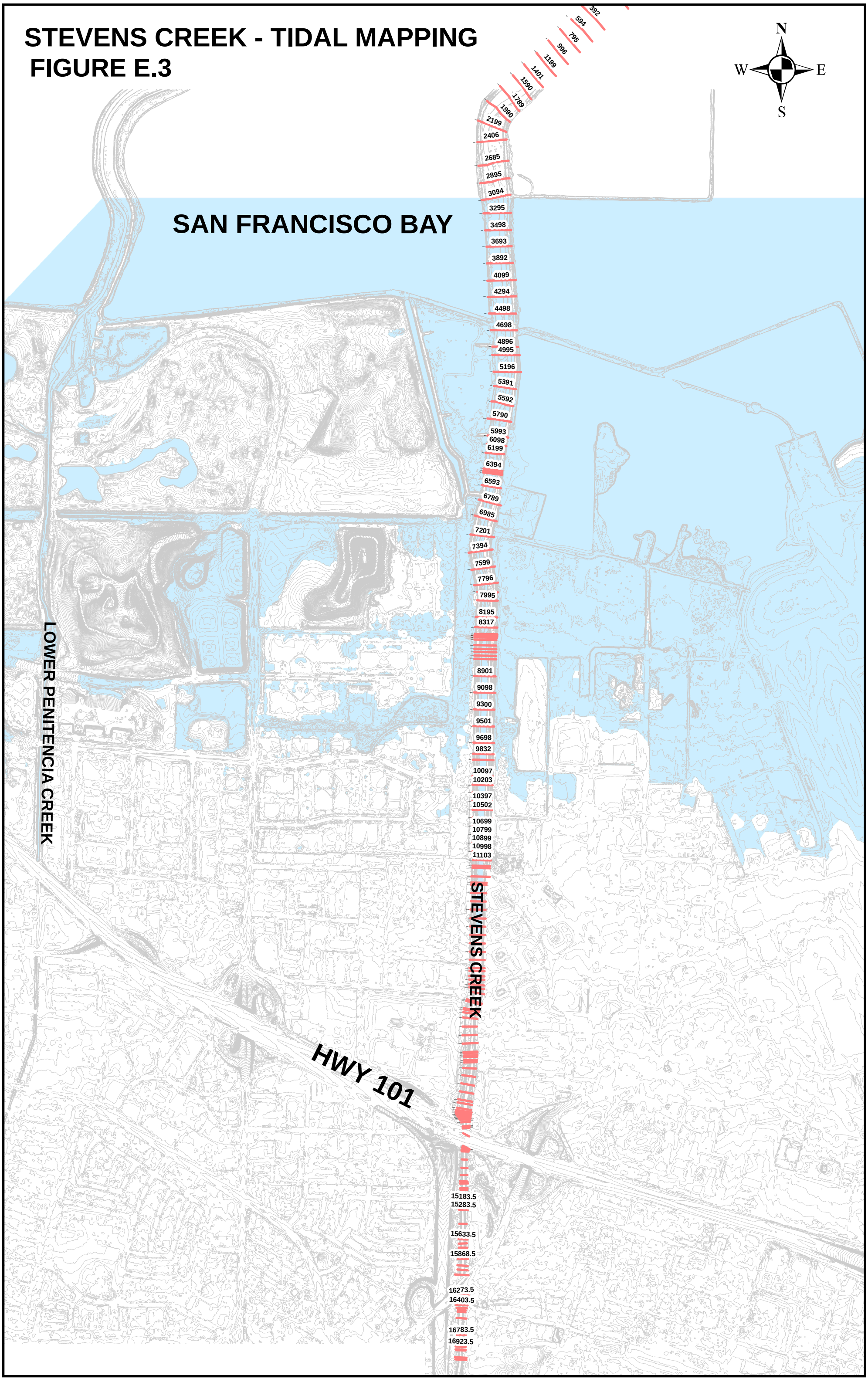


FIGURE E.2

STEVENS CREEK - TIDAL MAPPING
SAN FRANCISCO BAY
LOWER PENITENCIA CREEK
STEVENS CREEK
HWY 101
2199
2406
2685
2895
3094
3295
3498
3693
3892
4099
4294
4498
4698
4896
4995
5196
5391
5592
5790
5993
6098
6199
6394
6593
6789
6985
7201
7394
7599
7796
7995
8195
8317
8901
9098
9300
9501
9698
9832
10097
10203
10397
10502
10699
10799
10899
10998
11103
11299
15183.5
15283.5
15633.5
15868.5
16273.5
16403.5
16783.5
16921.5
N
W
E
S

STEVENS CREEK - TIDAL MAPPING
FIGURE E.3



Appendix F

Figures and Tables
Extracted from Santa Clara Valley Water District

C.3 Runoff Curve Numbers for Urban Areas

C.7 Manning's Roughness Coefficient for Overland Flow

Table C.3 RUNOFF CURVE NUMBERS FOR URBAN AREAS[1]

Cover Description		Curve No. for Hydrological Soil			
Cover Type and Hydrologic Condition	Average Percent Impervious area[2]	A	B	C	D
Fully developed urban areas (vegetation established)					
Open Space (lawns, parks, golf courses, cemeteries, etc.)[3]:					
Poor Condition (grass cover 50%)	--	68	79	86	89
Fair condition (grass cover 50% to 75%)	--	49	69	79	84
Good condition (grass cover 75%)	--	39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc.(excluding ROW)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding ROW)[4]	--	98	98	98	98
Paved; open ditches (including ROW)		83	89	92	93
Gravel (including ROW)	--	76	85	89	91
Dirt (including ROW)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious area only)[5]	--	63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2- inch sand or gravel mulch and basin boarders)	--	96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious area only, no vegetation)[5]	--	77	86	91	94
Idle lands (CN's are determined using cover types similar for other agricultural lands)					

1. Average runoff condition, and $I_a = 0.2$ S.(Source: Computational Hydrology in Flood Control Design and Planning)
2. The average percent impervious area shown was used to develop the composite CN's.
Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition.
3. CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations.
4. ROW = right-of-way. 5. Composite CN's should be computed based on percent of areas of different soil types.

Table C.7 Manning's Roughness Coefficient for Overland Flow*

Surface Type	Manning's n Value
Asphalt	0.010 - 0.015
Concrete	0.010 - 0.013
Bare Sand	0.010 - 0.016
Graveled Surface	0.012 - 0.030
Smooth Pavement	0.02
Packed Clay	0.03
Bare Clay - Loamed Soil(eroded)	0.012 - 0.033
Bared Packed Soil Free of Stone	0.10
Fallow - No residue	0.008 - 0.012
Conventional Tillage - No Residue	0.060 - 0.120
Conventional Tillage - With Residue	0.160 - 0.220
Chisel Plow - No Residue	0.060 - 0.120
Chisel Plow - With Residue	0.100 - 0.160
Fall Disking - With Residue	0.300 - 0.500
No Till - No Residue	0.040 - 0.100
No Till (20-40% Residue Cover)	0.070 - 0.170
No Till(60-100% Residue Cover)	0.170 - 0.470
Sparse Rangeland with Debris:	
0 Percent Cover	0.090 - 0.340
20 Percent Cover	0.050 - 0.250
Sparse Vegetation	0.053 - 0.130
Short Grass Prairie	0.100 - 0.200
Poor Grass Cover on Moderately Rough Bare Surface	0.30
Light Turf	0.20
Average Grass Cover	0.40
Dense Turf	0.170 - 0.800
Dense Grass	0.170 - 0.300
Bermuda Grass	0.300 - 0.480
Dense Shrubbery and Forest Litter	0.40

* Various study results compiled and discussed by Hjelmfelt (1986).

TAB 9

1. PURPOSE and SCOPE:

Adequate levee inspection and maintenance is essential for providing a reliable flood protection system, reducing the risk of flooding and loss of life and property, as well as maintaining compliance with State and Federal regulations for funding and flood insurance requirements. Adequate levee maintenance also ensures the accessibility and serviceability during flood events for emergency work.

This document describes general procedures and guidelines for field operations levee inspection and record keeping. The “levee” as defined here refers to all elements of the flood protection system. This includes the embankment itself and any stability or seepage berms, toe drains, flood walls, relief wells, and any waterside erosion protection system. It also includes other ancillary structures, facilities and appurtenances encroaching on the levee.

2. REFERENCE DOCUMENTS:

	Levee Safety Technical Guidance Manual
	Annual Levee Inspection Report
	Event Levee Inspection Report
	Facility Maintenance Guidelines/Agreements
	As-Built Levee Plans
	SMP Binder (BMP Manual/Permits and Supporting Material)
	FC 441 (03-21-89)
	Request for Services (Engineering Services Division- Survey Request)
WQ75101	Field Operations Work Order Process
WQ75115	Develop Engineering Field Instructions
WW75100	Vegetation Control Work Instructions
WF75118	Ordinance Violation Form
WF75161	Levee Field Inspection Rating Guide
WF75165	Field Inspection Checklist
	Levee Inventory List (watershed specific)

3. DEFINITIONS:

Levee – An embankment raised to prevent a watercourse from flooding. The “levee” as defined here refers to all elements of the flood protection system. This includes the embankment itself and any stability or seepage berms, toe drains, flood walls, relief wells, and any waterside erosion protection system. It also includes other ancillary structures, facilities and appurtenances encroaching on the levee.

Net grade – The as-built elevation of a levee.

Event driven inspection –
An inspection that should take place during or immediately after a natural hazard such as flood, earthquake, storm and other events having the potential of damaging the flood control system

4. Requirements:

ISO 9001
7.5.1 Control of Production and Service Provision

ISO 14001
4.4.6 Operational Control

Other Requirements
District Pesticide Policy (AD-8.2)

SMP Permits & CEQA documents

5. MONITORING AND MEASUREMENT:

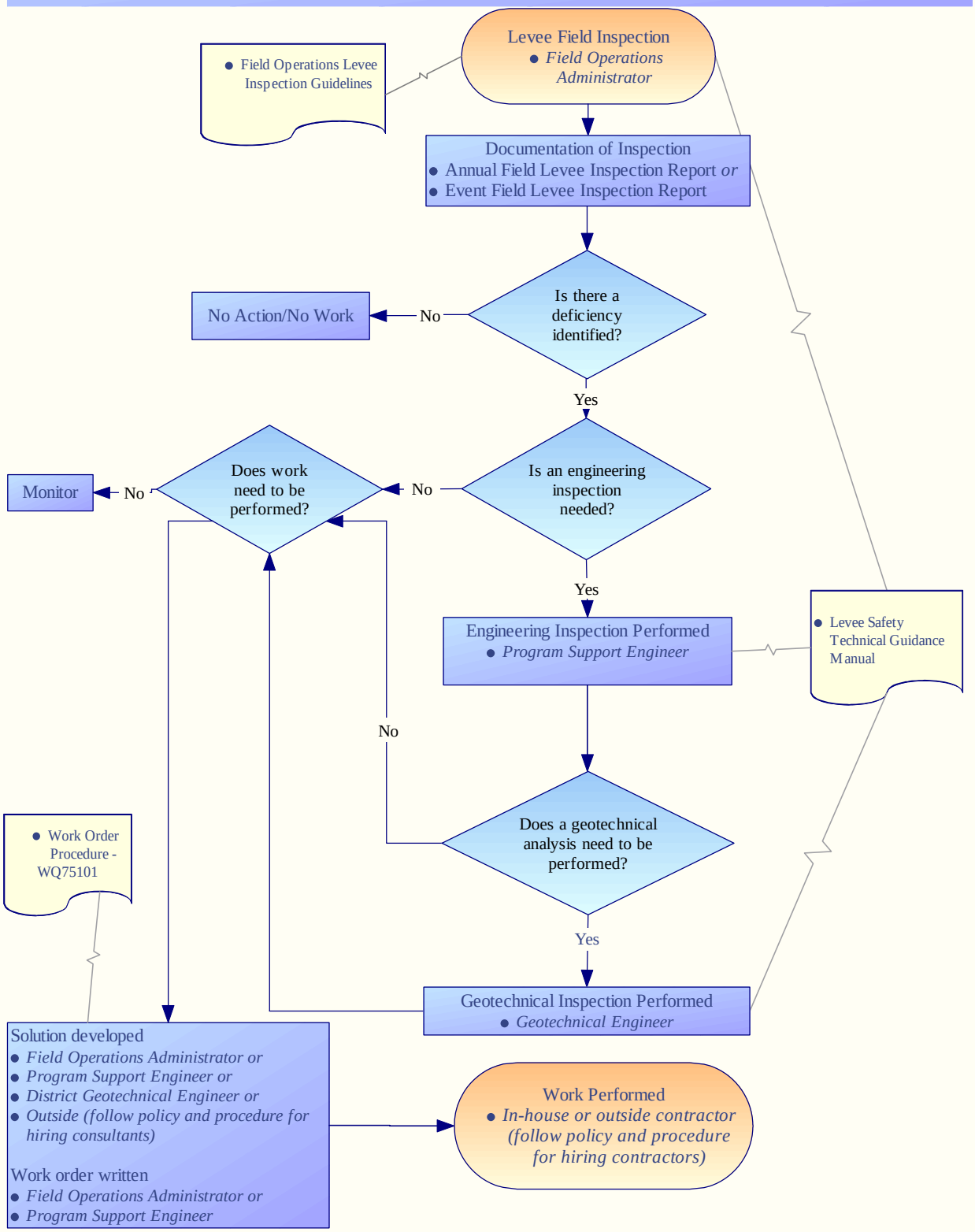
None

6. Procedures/Guidelines

6.0.1 Field Operations Levee/Work Inspection Flow Chart

The following flowchart represents typical critical paths from initial levee inspection to final work initiation. Although this flowchart cannot be used for every levee inspection/work scenario, it is shown here to represent a basis for most typical situations.

LEVEE INSPECTION/WORK FLOWCHART



6.1.0 Field Operations Levee Inspection Procedure

Overview	Details	Quality Records
(1) Plan inspections (Field Operations Administrator (FOA))	• **Routine Field Levee Inspections** are conducted by the Field Operations Administrator to inventory deficiencies including those that may threaten the integrity of the levees within the watershed. • Inspection frequency should be governed by government minimum requirements, facility maintenance guidelines/agreements and the perceived needs for inspections. In absence of documented mandated inspection frequencies, levees should be inspected at least annually. This inspection may be scheduled at least annually, so that any needed repairs could be designed and constructed prior to the next rainy season. • Identify all District levees within each Watershed using the levee inventory list. The Levee Inventory List is compiled, maintained, and kept by FOA. • Prepare a schedule of levee inspections	Levee Inventory List
↓		
(2) Inspect Levees (Field Operations Administrator (FOA))	• The annual inspection involves walking the levees and noting any observable distress. All relevant aspects are noted in section in section 9, ADDENDA: Levee Inspection Guidelines should be inspected and documented. • The Field Inspection Checklist shall be used to capture all field gathered data. Field-gathered data including location, description of findings and photo documentation are transferred into the Oracle online photo archive database and then compiled into an Annual Levee Inspection Report. • The results from the levee field inspections are categorized in inspection reports providing site specific information for on-going monitoring and prioritizing deficiencies. The report is also used to identify and prioritize other minor routine maintenance in levees. • A report of inspection will be prepared by the *field operations administrator* for permanent record, reference, and as a basis for needed remedial work for all periodic inspections. This report should be based on a systematic field inspection of each facility	Field Inspection Checklist Levee Inspection Report

Overview	Details	Quality Records
	and its individual components regarding its safety, stability, and operational adequacy.	
↓		

(3)
 	
Event driven Inspections
 	
(Field Operations Administrator (FOA))
	• **Event driven inspections** should also take place during or immediately after a natural hazard such as flood, earthquake, storm and other events having the potential of damaging the flood control system.
	• A record of emergency investigation containing all pertinent information should be prepared and filed as part of the flood control system record.
	• There should be additional inspections after significant events such as floods and earthquakes. The emphasis of these inspections will depend on the event triggering the inspection.
	  o Specific items to be checked should include: waterside erosion protection and encroachments, evidences of seepage, levee settlement, slumps, lateral spreading, cracking, evidence of liquefaction (boils and cracking), and slope failures.
	  o Other items to be observed and reported should include any mechanical equipment and facilities such as pipes, gates and valves, inlet and outlet structures, and bridge abutments.
	• The earthquake inspection should be particularly urgent if the earthquake were to occur just before or during the rainy season.
	• During flood periods, frequent patrols of the levee should be made to locate flood-related deficiencies in levees, floodwalls and other flood control structures and facilities. The specific frequency of these patrols will depend on the flood level, and may vary from daily to essentially continuously.
	• A report of an event driven inspection will be prepared by the FOA for permanent record, reference, and as a basis for needed remedial work for all periodic inspections. Field-gathered data including location, description of findings and photo documentation are transferred into the Oracle online photo archive database and then compiled into an Event Levee Inspection Report.
		Event Levee Inspection Report

↓		
(4) Deficiency Correction	• If a deficiency revealed during the course of the field levee inspection requires correction, a solution is developed by the FOA and implemented.	

Overview	Details	Quality Records
(Field Operations Administrator (FOA))	• FOA will document any work required in accordance with WQ75101 Field Operations Work Order Process • If the FOA determines that a deficiency revealed during the course of the field levee inspection requires engineering analysis, the Watershed *program support engineer* shall be consulted and if necessary, a solution developed. The Watershed program support engineer will develop a solution in accordance with WQ75115 Develop Engineering Field Instructions. • If the *Watershed program support engineer* determines that a geotechnical inspection is necessary, a *geotechnical engineer* or *outside consultant* shall be consulted, and if necessary, a solution developed.	

7. Quality Records:

QUALITY RECORD	Location Kept	Filing Order	Duration Kept	Disposition	Comments
Levee Safety Technical Guidance Manual	Online at the watershed released work instructions webpage	N/A	permanently		
As-Built Levee Plans	central files, project leads	facility name, number and date	permanently		
BMP Checklists	BMP Binder & Work Order Package	Activity, Facility Number, & Date	Until close of fiscal year	Binders archived in Stream Water Quality	
Maximo WO Daily	work order package	facility number & date	until close of fiscal year	archived in field operations vault	
Facility Maintenance Guidelines/ Agreements	central files, project leads, online permit database	facility name, number and date	permanently		

QUALITY RECORD	Location Kept	Filing Order	Duration Kept	Disposition	Comments
Levee Field Inspection Checklist	field operations administrator's office and computer	facility name, number and date	permanently		
Annual Levee Inspection Report	field operations administrator's office and computer	facility name, and date	permanently		
Event Levee Inspection Report	field operations administrator's office and computer	facility name and date	permanently		
Levee Inventory List	field operations administrator's office and computer	facility name and date	permanently		

8. Change History:

Date	Revision	Comments
12/19/06	R1	New release

9. ADDENDA:

Levee Inspection Guidelines

More detailed information can be in the Levee Safety Technical Guidance Manual

The guidelines listed below were derived from the Levee Safety Technical Guidance Manual (29 April 2002) and are intended as a general basis for conducting field operations levee inspections. All aspects of the guidelines will not apply to every levee situation and must be applied on a case-by-case basis as appropriate.

Flood Control Levees

Levee Geometry

Inspection should identify any apparent deviations from the as-built geometry of the levee. Levee embankments should be maintained to not less than the net grade and section by replacing any loss of material from the crest, slopes, or any bench/berm. Ruts, washes, slides and subsidences should be noted and promptly repaired and the entire embankment maintained sufficiently smooth for power mowing. Levee crests should be graded as necessary to drain freely and prevent impoundment of rain water. When the crest of the levee is used as maintenance road, and unless the crest road is paved in accordance with standard roadway pavement and traffic criteria, the levee crest should be covered by at least 6 inches of a gravel/aggregate base overlying a filter fabric.

Cracking

During the levee inspection, any observed cracks along the crest or the side slopes should be recorded for further assessment of impact on levee integrity. Longitudinal cracks with down scarps toward the levee slope may be an indication of incipient slope instability. Generally these surface cracks will exacerbate potential sloughing or sliding during wet and prolonged rainy seasons. As the water infiltrates the cracks, it adds lateral hydrostatic pressures on the walls of the cracks and hence promotes potential slips. Random cracks that do not show any sign of down slope movements are generally caused by high shrink-swell levee material, such as high-plasticity clay or organic rich material. The long term cycles of shrink-swell may cause the levee material to deteriorate and weaken. It is recommended that these cracks be repaired as soon as reported.

Erosion and Condition of Slope Protection

Erosion or scour of levees and banks commonly occurs along non-protected levee and bank slopes. The amount and extent of erosion depend typically on the flow velocity, material-type irregularities and contacts between hard and soft material. Silty and sandy unconsolidated alluvium are highly susceptible to erosion and scour. Even levees and banks equipped with erosion protection can experience scour during high river stages. Usually these occurrences take place in areas where the erosion protection system has not been well maintained and has deteriorated with time, or in areas where the erosion protection system was under-designed for the damaging flood. Erosion protection comes in various forms; from concrete surfacing and rock protection to more environmentally friendly solutions such as bio-engineered slope protection, to non-protection by design to allow the river to meander and run its natural course. The latter usually is associated with a system of set-back levees.

When slope erosion protection is provided, observations during the levee inspection should ascertain that the erosion protection is maintained in accordance with the intent of the design; that the levee maintains its uniformity and its integrity; that no irregularities are developing that may become points of weakness. If such events are observed, repairs should be undertaken immediately to bring the protection system to its original design.

Erosion and scour are probably the leading cause of levee failures during flood events. Levee material, rock, plastic sheeting (Visqueen), and filter fabric should be stockpiled near the flood control system in locations where it is quickly and efficiently accessible for emergency fight/repairs.

Levee Settlement and Subsidence

The levee crest may be lowered over time due to settlement or subsidence.

Settlement is a lowering due to consolidation of underlying compressible soils under new applied loads. Typically settlements under the self-weight of the levee are estimated prior to construction, and the levee is overbuilt by an appropriate amount. However, there may be other factors causing later levee settlements. There may be compressible layers or lenses that were not adequately recognized in design. There may have been later nearby construction that has applied additional loads on the soils under the levee. There may have been loss of ground from under the levee due to internal erosion or due to adjacent excavations. Or there may have been slumping of the entire levee due to overstressing of foundation soils.

Levee settlements and differential settlements, and their observation, are particularly important for levees constructed on compressible soils, as is typically the case for levees built near the Bay.

Subsidence is a lowering of the levee crest over some length of the levee, due to deep-seated compression of soil strata caused by extraction of water, gas or oil, or due to underground mining. Other causes of long-term subsidence are compressibility of organic peat layers as a result of ongoing oxygen reduction and decomposition (i.e. due to farming practice).

In either case, the lowering of the levee crest might compromise the flood protection of the subject levee. Levee inspection should look for signs of crest lowering over short stretches of the levee crest. Any such evidence should be noted and followed promptly by a topographic survey of the levee crest. Levee crest lowering over some length (say, hundreds of feet) can probably only be identified by an elevation survey. Such surveys are advisable at regular internals (i.e. 5-year intervals).

Landside Seeps and Boils

Seepage is prevalent along flood control levees. Generally the flood control system first built around the turn of the century consisted of dredging/excavating local materials (undiscriminated) to build heterogeneous earth embankments, by hydraulic filling or by dry construction with nominal compaction. Similarly the foundations supporting the constructed levees were typically not engineered to remove weaknesses. At that time, the levee system was probably built to provide sufficient lead time for a flood fight response. However, in today's urban environment with permanent structures and facilities, a higher (permanent) protection level is required. Because of the condition of the levees and foundation, seepage is often observed during flood events. Both seepage through the levee and underseepage are common. Pervious layers within the levees or in the foundation have caused seeps to occur on the side slopes of the levees and seeps and boils near the levees' landside toe. Emergency response during a flood event typically involves the construction of sandbag rings around boils to slow the migration of fines out of the foundation soils by allowing a hydrostatic head to build up inside the sandbag ring.

When observed, seeps and boils should be recorded in the field noting location, size, and amount of soil ejected with the flow of water. A note should also be made as to whether the boils are stable or growing in size. If the seeps and boils are evolving and give indication of potential deteriorating conditions, an evaluation should be made to assess the criticality of the situation and develop prompt remedial measures.

Prevention of Encroachment

Inspection should verify that the levees are not encroached upon. Buildings, structures, and storage of miscellaneous materials or equipment should not be permitted on the levee. Refuse dumps are an item of frequent concern and should not be permitted. Following each high water season, any drift which has been deposited on the channel and levee slopes should be removed promptly.

In areas where landside seepage berms are not presently provided, but where foundation conditions indicate that such berms may be needed to control underseepage, consideration should be given to preventing encroachment into the area that future berms may occupy.

River Channel

The river channels and overflow banks are natural areas of planned and unplanned riparian vegetation. Unplanned growth, if abundant, can restrict channel hydraulic capacity, particularly at constricted locations such as at bridge overpasses, culverts and other river crossings. It is recognized that most of the vegetation and trees within the river channel and banks foster and restore riparian corridors and shaded riverine canopy that are necessary and essential for terrestrial and aquatic life. Habitat is highly regulated by State and Federal agencies. If serious obstructions, due to vegetation growth, threaten the flood control system, these observations should be noted and reported. If the problem has been identified both from the field observation and analysis models, than corrective measures should be developed.

Sediments tend to deposit in areas of grade lowering energy dissipating structures and diversion facilities. The inspection should note and report the degree of silting that is occurring along these facilities, and make recommendations for cleaning and de-silting the obstructed facilities.

Floodwalls and Retaining Walls

As part of the periodic inspections, floodwalls and retaining walls in levees should be inspected for any distress including: cracking, undermining (scour, erosion at the wall footing), settlement, misalignment, and any other signs that could potentially affect the structural integrity of the walls. The levee inspector should look for and record with photographs and drawings, indicating exact locations with respect to levee miles and offset distances from the levee centerline, any signs of:

- Wall cracks, fissures, chipping, and breaks or spalls
- Settlement and offsets
- Out of plumb and misaligned sections of walls
- Seepage, boils, and saturated areas
- Scour holes and erosion
- Roots that may undermine the wall footing
- Accumulation of trash, debris or any undesirable rubbish
- Unauthorized encroachment such as: floating plants or boats against or tied up to the floodwall.

Structures, Facilities and Appurtenances

Various facilities and appurtenances encroach on the levees. Care should be taken to verify during inspections that these facilities are operating in satisfactory conditions. Because these facilities generally create a hard contact with the levee/bank material, inspection for scour and undermining at these localities is important. Items for inspection should verify that:

- Pipes, gates, and valves are in good working conditions and that no erosion is occurring around pipes and drainage structures.
- Grade control and energy dissipating structures are not undermined and exposed or silted up.
- Drainage ditches and channels are open and clear from overgrowth and any undesirable rubbish that may impact the normal flow and proper discharge. Note abnormal occurrence of silt and sand mounds within the drainage ditches.
- Drainage inlet structures are inspected and kept free from debris and accumulation that may cause clogging.
- Flap gates on storm drainage discharge pipe outlets are kept clean from accumulated debris between the gates and the pipes which could impede the normal function of the gates.
- Bridge and culvert abutments should be checked for structural distress and erosion effects.
- Pumps are well maintained and in good working condition.

Miscellaneous Levee Facilities and Appurtenances

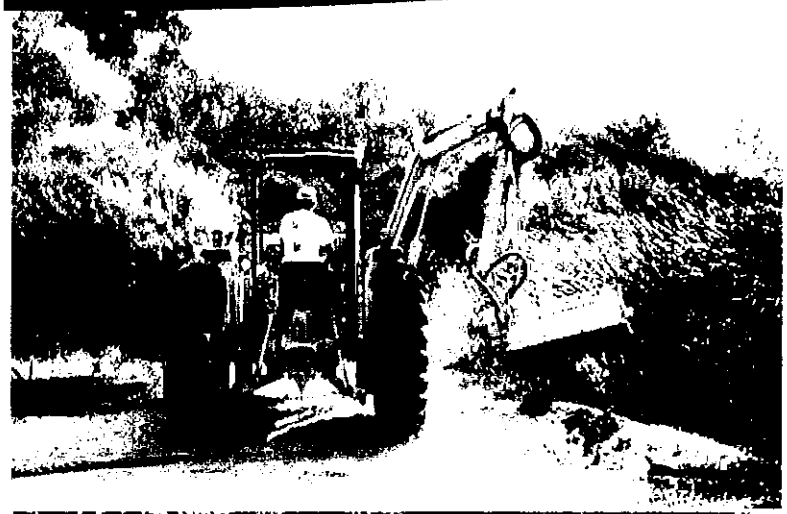
Miscellaneous levee facilities that are constructed on, over or through the levee should be maintained in a good state of repair and/or in good operating condition. The condition of these facilities should be inspected at least annually, and those items that are operative only during high river stages should be checked carefully and repaired as necessary immediately prior to the high water season. Relief wells should be checked during periods of high water. Wells that do not flow for an extended period of time may have to be tested by pumping to determine the extent of deterioration. Where wells are found to be critically deteriorated, they should be rehabilitated by cleaning, surging, and pumping. Check valves should be inspected to ensure that they open freely and that the gaskets are in good condition.

Periodic Elevation Surveys

Periodic surveys of the elevation of the levee crest are advisable to monitor any potential deviation from the design levee profile. Specific facility maintenance guidelines and/or agreements may dictate survey requirements.

Santa Clara Valley
Water District

SHREE DHARASHKER



Final Environmental Impact Report for the Multi-Year Stream Maintenance Program

August 2001

II.A. SUMMARY - FINAL ENVIRONMENTAL IMPACT REPORT

The entire summary from the draft EIR has been reproduced here with additions under the FEIR indicated by underlined text and deletions indicated by ~~strikeout~~.

A. THE SANTA CLARA VALLEY WATER DISTRICT

The Santa Clara Valley Water District ("District") is a special purpose governmental agency responsible for providing water supply and flood protection for Santa Clara County, California in cost effective and environmentally responsible manner. For flood protection, all creeks in Santa Clara County with a watershed greater than 320 acres are in the District's jurisdiction.

B. PROPOSED PROJECT: THE STREAM MAINTENANCE PROGRAM

1. Changes in the Final Environmental Impact Report

Two major changes have been made in the Final Environmental Impact Report (FEIR) in response to comments: the Modified Pajaro River Basin Alternative is designated as the Preferred Alternative, and additional mitigation is proposed for certain types of bank protection work.

To reduce the environmental effects of the project to wetlands, the Preferred Alternative is revised to be the Modified Pajaro River Basin Alternative rather than the Multi-Year Program Alternative. Under the Modified Pajaro River Basin Alternative, herbicides would continue to be the primary method by which vegetation is managed in the Santa Clara Basin. Because of concerns regarding the gradual environmental change to wetlands, herbicide use in the Pajaro River Basin will be limited to upland areas and the control of non-native invasive plants.

As described in detail in revised Appendix E of the SMP, additional mitigation is proposed for bank protection projects which include rock or impervious structures. A minor additional change in the FEIR includes clarification of the Llagas Creek and Pajaro River areas which is defined as outside the scope of routine maintenance.

2. The Scope of the Stream Maintenance Program

The Stream Maintenance Program (SMP) describes a proposed program for conducting routine stream and canal maintenance. The program is intended to be ongoing and can be modified as conditions change. The program is intended to apply to three major activities, sediment removal, vegetation management, and bank protection, and a group of minor activities. The program is intended to cover these activities wherever they may occur in the District's jurisdiction, subject to several specific limitations.

The SMP incorporates several explicit steps for evaluating and reporting the effectiveness of the mitigation in the Program (see SMP Figure 3-1, SMP Resource Protection Protocol). This cycle of annual evaluation and improvement makes the SMP capable of adapting to new information and changing conditions to improve Best Management Practices (BMPs) effectiveness. It is expected that the full suite of resource protection incorporated in the SMP will allow the District to minimize environmental effects under a wide range of actual work needs.

3. Sediment Removal

Sediment removal occurs when an accumulation of sediment (1) reduces flood water conveyance capacity, (2) prevents facilities or appurtenant structures from functioning as intended, or (3) impedes fish passage and access to fish ladders. Thus the overall purpose is to ensure the proper function of District facilities.

The District estimates that it removes an average of 80,000 cubic yards of sediment on about 16 miles of channel per year in Santa Clara County. The actual quantity and location varies from year-to-year depending, in part, on rainfall of the past season. Cumulatively, sediment removal is projected for approximately 60 miles of streams. Sediment removal from canals is estimated to be less than 1000 cubic yards per year.

Sediment removal generally occurs between July 1 and October 15. A variety of heavy equipment is used. The average duration of a sediment removal project is 10 days. Appropriate temporary dams and pipes are used if water must be bypassed around the site during work. Excavated sediment is disposed at a landfill or other suitable site.

3. Vegetation Management

Vegetation management removes plant growth which blocks channels or which reduces flood flow. Vegetation management helps maintain the ability of channels to function as flood protection channels and also provides control of invasive, non-native plants and control of weeds at revegetation sites. The District also manages vegetation to protect levees and concrete linings from plant roots; to meet local fire codes; to provide visual clearance of a facility; and to provide access along maintenance roads. Depending on the original design and the characteristics of the channel, the frequency of vegetation management varies from annually to every few years.

In many creek sections, both sediment removal and ~~aquatic herbicide application~~ vegetation management are done in different years within the maintenance cycle. For example, in the year following sediment removal, herbaceous wetland vegetation may become established, and in the third year, may pose a potential flood hazard. Herbicide is applied to kill the vegetation, and herbicide application may continue in subsequent years before sediment accumulates until it eventually reaches a point where flood capacity is significantly reduced and sediment removal is again required. Or, other methods of vegetation management, such as mechanical or hand control methods, can be used instead of herbicides in the years between sediment removal.

Herbicides are used extensively and are preferred by reason of lower cost over mechanical and hand control methods. Currently, the District does not use herbicides in the Pajaro River Basin ("South County"), but would do so on a limited basis under the preferred alternative for the SMP. The herbicide use in the Pajaro River Basin would be limited to upland areas and (including adjacent upland areas, channel banks, channel benches, levee slopes, mainenance roads and firebreaks above the channel bottom) for control of invasive exotic plants ~~on approximately 56 miles of channel, 11 miles of which would be done in conjunction with sediment removal~~. Vegetation in these areas of the Pajaro River Basin is currently controlled by hand or mechanical methods.

Currently, the District uses glyphosate (Monsanto's Roundup® Pro and Aquamaster®, an aquatic formulation formerly marketed as Rodeo®) to control in-channel vegetation. Upland herbicide spraying applies to levees, unpaved maintenance roads, District right-of-way, and along some property lines. Pre-emergent herbicides control vegetation on levees and access roads by preventing the germination of weed seeds. The District uses a range of pre-emergent herbicides, including pendimethalin and chlorsulfuron. This particular application may change to reflect new restrictions under consideration by the California Department of Pesticide Regulation.

4. Bank Protection

Bank protection involves an action by the District to repair stream banks that are eroding or are in need of preventative erosion protection. The District may implement bank protection when the problem (1) causes or could cause significant damage to a property or adjacent property, (2) is a public safety concern, (3) adversely affects transportation or recreational use, (4) adversely affects water quality or beneficial uses, or (5) adversely affects riparian habitat. Based on past experience, the District estimates that an average of one linear mile of stream banks

may be repaired each year spread over some 30 to 50 individual work sites. Work is usually done between July 1 and October 15.

Bank repairs may take several forms from installing "hard" structures (e.g., rock blankets, concrete, sack concrete, gabions) to "soft" structures (e.g., willow brush mattresses, log crib walls, pole plantings) or a combination of hard and soft structures. An important feature of the SMP is a programmatic approach to impact assessment and mitigation at bank protection sites that takes into account fisheries and riparian resources values (SMP Appendix E). The bank protection work would include both hardscape and softscape designs with mitigation provided at a 1:1 ratio by area of streambank for rock hybrid designs with plantings and a 3:1 ratio by area of streambank for impervious hardscape and other rock designs without plantings. On an average annual basis, no more than one-half mile of impervious hardscape designs will be installed. ~~The District will install no more than 50% of future bank protection projects under the SMP as hardscape.~~

5. Minor Activities

Minor maintenance activities include trash removal, installation of fences and gates; repairs to restore access roads and levees; grading small areas to improve drainage and reduce erosion; repair to existing structures (e.g. replacement of concrete linings and culverts); sediment removal at stream gages, outfalls, culverts, flap gates, tide gates, inlets, grade control structures, fish ladders, fish screens; graffiti removal; tree pruning along maintenance roads; irrigation, weeding, replanting and other maintenance at mitigation sites; removal of obstructions to flow at bridges, streamflow measuring stations, box culverts, storm drain outfalls and drop structures; removal of trees in danger of falling, fallen trees, and associated debris to maintain channel design capacity; and ground squirrel and rodent control with traps, smoke bombs, and pesticides.

6. Mitigation Incorporated in the Project

Chapter 4 of the SMP presents policies to protect resources during the implementation of routine stream maintenance activities. These policies provide guidance to District managers and staff in the environmental review, design, and implementation of individual stream maintenance projects. BMPs have been developed to implement each of these policies and to mitigate environmental impacts identified in the EIR.

a. Best Management Practices (BMPs)

The SMP has specifically developed BMPs applicable to routine stream maintenance, and these are incorporated into the SMP (SMP Appendix G). The BMPs provide mitigation for potential Water Quality, Vegetation, Wildlife and Fisheries, Land Use and Cultural Resources impacts. In the Final Environmental Impact Report, many of the BMPs have been revised in response to comments on the Draft Environmental Impact Report.

b. Wetland and Riparian Compensation

Over the long-term, the SMP has the potential to significantly affect the ecological and biological environment of Santa Clara County by cumulatively affecting wetland habitats, including tidal and freshwater wetlands and riparian habitats. Though measures in this EIR will avoid or reduce these impacts, the District acknowledges that it would not be to a less-than-significant level if compensatory mitigation were not provided.

The SMP includes a compensatory mitigation package to compensate for the significant residual impacts of sediment removal and vegetation management on in-stream wetlands and riparian vegetation. The compensatory mitigation package includes the following components: (1) tidal wetland restoration; (2) freshwater wetland creation;

(3) stream and watershed protection; and (4) control of giant reed. This mitigation is described in detail in Chapter 5 of the SMP.

Bank protection is addressed by the Programmatic Impact and Mitigation for Bank Protection protocol (SMP Appendix E) which compares the intensity of the work method and amount of hardscape against the environmental sensitivity of the work location. ~~Impact and mitigation are balanced between individual projects.~~ Appendix E provides a matrix for assessing the impacts and mitigation needed for bank protection measures. Additionally, a mitigation program has been added to the SMP for bank protection activities that include some form of hardscape or rock.

c. Special-Status Species

The avoidance and minimization measures incorporated in the project, described in SMP Chapter 4, are considered sufficient to reduce most, but not necessarily all, potential impacts of the SMP on special-status species to a less-than-significant level. Residual impacts are reduced to less than significant by specific provisions in the compensatory mitigation program described above.

7. SMP Exclusions

a. Activities Outside of Routine Maintenance are Excluded

In the course of CEQA review, the District determined that there were possible channel maintenance activities that may not be accommodated by the BMPs and other programmatic mitigation proposed as part of the SMP. The following maintenance activities are excluded from the SMP: sediment removal and vegetation management on stream reaches above the 1,000-foot elevation contour which is above the reservoirs; hardscape bank protection projects which occur in high quality fisheries habitat or existing high quality riparian habitat, and ~~initial removal of in-channel trees~~ any sediment removal, wetland vegetation control, or removal of in-channels trees in Llagas Creek downstream of ~~Luchessa Avenue~~ Highway 152 to the confluence with the Pajaro River and in the Pajaro River within Santa Clara County.

b. Other Activities are Excluded

Routine maintenance restores flood conveyance capacity to design levels, but does not increase design capacity. The District also plans and carries out flood protection projects as Capital Improvement Projects (CIP). The CIP are subject to separate engineering and environmental review which will take into account project specific impact and mitigation. Once the CIP is completed, maintenance at the project site will be incorporated into the SMP.

The SMP does not include certain other District maintenance activities such as percolation ponds, in-stream water infiltration barriers (summer dams), or dam and reservoir maintenance.

C. REGULATORY SETTING

1. CEQA

The District acts as the lead agency in fulfilling the requirements of the California Environmental Quality Act (CEQA).

EXCERPTS FROM

SANTA CLARA VALLEY WATER DISTRICT

STREAM MAINTENANCE PROGRAM

Chapter 1
INTRODUCTION

This chapter describes the objectives and applicability of the Santa Clara Valley Water District's (District) Stream Maintenance Program (Program). As a foundation for understanding the resource protection and maintenance issues discussed in this report, this chapter also defines routine stream maintenance and briefly describes the District's facilities where stream maintenance is required. In conclusion, this chapter provides a summary of related programmatic documentation that is required for implementation of the Stream Maintenance Program and the organization of subsequent chapters.

A. PROGRAM PURPOSE AND OBJECTIVES

The Stream Maintenance Program is designed to provide long-term guidance to the District to implement routine stream and canal maintenance projects in order to meet the District's flood protection and water supply mandates in a feasible, cost-effective, and environmentally-sensitive manner. This authority is provided by the District Act, as amended. The main goals of preparing the Stream Maintenance Program are to maintain streams and canals to meet their original design to provide flood protection and water supply, coordinate the various aspects of routine stream maintenance to better achieve this goal, and assist in obtaining multiyear permits. The Stream Maintenance Program only applies to District facilities.

The objectives of the Stream Maintenance Program are as follows:

1. Standardize practices and protocols for routine sediment removal, vegetation management, and bank protection in and around the streams and related facilities within the District's jurisdiction.

2. Identify cost-effective routine stream maintenance practices and protocols.

3. Ensure routine stream maintenance activities reflect the District's policies of environmental protection and stewardship.

4. To the extent practical, avoid or minimize adverse environmental effects and encourage preservation and restoration.

5. Establish effective and economically-practical compensatory mitigation for environmental impacts from routine stream maintenance activities.

6. Establish practices and protocols that optimize operational flexibility and allow the integration of lessons learned and improvements in Best Management Practices.

The Stream Maintenance Program will be used by District staff to ensure that routine stream maintenance practices are conducted in an efficient, consistent, and environmentally-sensitive manner.

B. APPLICABILITY AND USE OF THE STREAM MAINTENANCE PROGRAM

The Stream Maintenance Program applies to all of the District's routine stream maintenance activities, including three major types of activities: sediment removal, vegetation management, and bank protection. Many of these activities are undertaken to ensure flood conveyance capacity is maintained in existing streams. In addition, routine maintenance includes vegetation removal in and around the streams and canals within the District's jurisdiction to ensure appropriate access and fire control. More minor maintenance activities are also included in the definition of routine stream maintenance.

The stream maintenance work area addressed by this Stream Maintenance Program includes the streams, canals, and any adjacent property that the District owns or holds an easement for access and maintenance. The District does not provide maintenance on private property when no easement exists. The maintenance work area is the stream channel or canal itself, typically extending to 20 feet past the top of bank when access is provided, and less when access is not provided. Creeks with constructed levees may require a wider maintenance easement. The maintenance work area is typically less than the District's permitting jurisdiction, which is within 50 feet of the top of bank of the streams.

The Stream Maintenance Program is designed to be a process and policy document that can be adopted by the District. Once adopted, the Stream Maintenance Program will be used by the District to guide the implementation of routine stream maintenance activities and projects. The Stream Maintenance Program outlines specific measures, protocols, policies, and reporting requirements to ensure that routine stream maintenance projects are implemented in an efficient and environmentally-sensitive manner. This Stream Maintenance Program is subject to future revisions as improvements and modifications are made to reflect the best available knowledge, technology, and practices.

The Stream Maintenance Program is intended to establish an ongoing District program of indefinite length. The Stream Maintenance Program uses a 20-year planning time frame to project the level of future work, and this same time frame is used by the Environmental Impact Report (EIR) to evaluate cumulative impact. Permits for stream maintenance from regulatory agencies are expected to last for a period of 10 years, after which the District would apply for a renewal. The Stream Maintenance Program will be reviewed annually as described in Chapter 3 to determine if adjustments to the BMPs need to be made. The overall program will be reviewed in 10 years as part of the permit renewal process.

The 20-year time frame was used because this is the period of time over which future work areas and impacts can be reliably projected. Projections for future work under the Stream Maintenance Program are based on an analysis of historical data going back to 1977. All forms of maintenance show a consistent pattern; however, projections of future stream maintenance activities for the Stream Maintenance Program cannot represent the exact extent of work that will occur. Actual stream maintenance activities vary from year to year. There may be some future routine maintenance activities that are within the District's jurisdiction and are consistent with the descriptions of work and impacts evaluated for the program overall but which were not specifically included in the District's projection of work areas. Maintenance at such sites is still included in the program as long as it does not result in significant environmental effects substantially different than those evaluated for the program as a whole.

If routine stream maintenance practices are substantially changed at any time, the program will be updated. If these changes would result in significant impacts not evaluated in the EIR, then the EIR will also be updated. New mitigation measures would not be required unless new significant impacts are identified.

Routine stream maintenance does not include emergency repair. A situation is considered an "emergency" if it is a sudden, unexpected occurrence involving a clear and imminent danger that demands immediate action to prevent or mitigate loss of or damage to life, health, property, or essential public services (Public Resource Code Section 21060.3).

Routine stream maintenance does not alter the flood conveyance or water supply capacity of a stream or canal. Large construction projects and Capital Improvement Projects (CIP) are not considered routine stream maintenance and are not addressed through the Stream Maintenance Program. For new CIPs, long-term maintenance impacts and any new mitigation will be analyzed under the CIP's separate future environmental review and compared to those impacts and mitigation previously evaluated for that reach of stream under the Stream Maintenance Program. New mitigation will only be required if the impacts of the maintenance under the CIP are in excess of impacts included in the Stream Maintenance Program for the same reach of creek. After the environmental review is completed for the CIP, the Stream Maintenance Program will be updated to incorporate any revisions to the mitigation program, and the implementation of the new maintenance and its annual reporting will be conducted in the same manner as indicated in Chapter 3.

The installation of new or major modification of fish ladders is not included in the Stream Maintenance Program. See also the "Overview of the Streams and Canals within the District's Jurisdiction" below for clarification on what areas are included or excluded from the Stream Maintenance Program.

C. STREAM MAINTENANCE ACTIVITIES

The following provides a brief discussion of the major activities addressed by the Stream Maintenance Program. For more information on these activities and why they are implemented, please refer to Chapter 2. In addition, the Stream Maintenance Program applies to more minor activities such as fence repair, trash removal, and removal of downed trees or other blockages.

1. Sediment Removal

Sediment removal is the act of mechanically removing sediment that has been deposited within a stream. Typically, sediment is removed when it: (1) reduces stream capacity, (2) prevents facilities or appurtenant structures from functioning as intended, or (3) impedes fish passage and access to fish ladders. Sediment removal can occur in the same physical area as vegetation removal.

2. Vegetation Management

The District removes vegetation in and adjacent to creeks and canals to maintain the ability of channels to function as flood protection facilities and canals to transport water. Vegetation removal can occur in the same physical area as sediment removal. In addition, vegetation is removed to meet local fire code requirements and to reduce combustible weeds and grasses on property adjacent to the streams within the District's jurisdiction. The control of invasive nonnative vegetation is another purpose for which the District undertakes vegetation control. Vegetation management can be accomplished through mowing, discing, hand clearing, or herbicide applications (depending on the environmental conditions of the site).

3. Bank Protection

Bank protection involves any action by the District to repair streambanks that are eroding as well as preventative erosion protection. The District implements bank protection when the problem (1) causes or could cause significant damage to a property or adjacent property, (2) is a public safety concern, (3) negatively affects transportation, (4) negatively affects beneficial uses of surface water, or (5) negatively affects riparian habitat. Repairs may take several forms ranging from the installation of "hard" structures (i.e., rock, concrete, sack concrete, gabions) to the use of "soft" structures (i.e., willow brush mattresses, log crib walls, pole plantings), or a combination of hard and soft structures. Bank protection also includes preventative maintenance to ensure that banks do not erode in the future. Such bank protection can reduce sedimentation and improve water quality.

Routine stream maintenance includes three major activities, as follows: (1) sediment removal activities that are designed to restore the flood conveyance capacity of existing District channels or associated features (e.g., tide gates), (2) vegetation management in and around streams and canals in the District's jurisdiction, including removal of

vegetation for flood capacity, access and fire control, and (3) bank protection activities necessary to protect District or other facilities. Routine stream maintenance also includes more minor maintenance activities, such as maintenance of revegetation sites, fence repair, trash removal, and removal of downed trees or other blockages from streams.

D. OVERVIEW OF THE STREAMS AND CANALS WITHIN THE DISTRICT'S JURISDICTION

For the purpose of this Stream Maintenance Program, "streams" are defined as natural watercourses and modified channels and canals that are within the District's jurisdiction. In this Stream Maintenance Program, streams include both the waterway and its immediate geographical corridor, including riparian corridors.

[Text describing the District's jurisdiction within the San Francisco Bay and Pajaro River watersheds is removed for brevity.]

E. RELATED PROGRAMMATIC DOCUMENTATION

Because this Stream Maintenance Program has been designed to guide the implementation of routine stream maintenance projects and activities over the long-term, it addresses stream maintenance at a general or "programmatic" level. As such, this document provides the guidelines and implementation measures that characterize how stream maintenance will be conducted by the District.

In addition to this document, several other programmatic requirements must be met before the Stream Maintenance Program can be implemented, as follows:

- **Program Environmental Impact Report**. Consistent with the California Environmental Quality Act (CEQA), an EIR will be prepared and certified by the District for this Stream Maintenance Program. The EIR will evaluate the potential environmental impacts of the Stream Maintenance Program and determine measures to mitigate impacts.

- **Long-Term Permits**. The District is seeking the approval of a long-term permit for routine stream maintenance activities in streams under the jurisdiction of the United States Army Corps of Engineers (USACE), including Waters of the United States and special aquatic sites (wetlands) pursuant to Section 404 of the Clean Water Act as well as Section 10 of the Rivers and Harbors Act. This Individual Permit would grant general authorization and set conditions for all routine stream maintenance activities subject to jurisdiction of the USACE. In addition, the District will be required to comply with requirements under Section 7 of the Federal Endangered Species Act (ESA). The California Regional Water Quality Control Boards (RWQCB) will also require compliance with Waste Discharge Requirements (WDR) permits and Section 401 of the Clean Water Act. The Santa

Clara Valley is divided into two RWQCBs, based on major drainage areas. These are the San Francisco Bay RWQCB and the Central Coast RWQCB.

The District will also revise Memorandums of Understanding with the California Department of Fish and Game (CDFG) for stream maintenance activities. The CDFG will review routine stream maintenance activities for consistency with California's endangered species protection regulations.

The San Francisco Bay Conservation and Development Commission (BCDC) regulates activities occurring in tidally-influenced areas. The BCDC renewed Permit No. M77-113 on July 28, 2000, to cover the District's routine stream maintenance activities that occur in or near tidal waters of San Francisco Bay. The expiration date is June 1, 2005.

The permits and approvals from these agencies for routine stream maintenance are expected to last for a period of 5 to 10 years, after which time applications will be made for renewal of these permits and approvals.

In addition to these programmatic requirements for adoption and implementation of the Stream Maintenance Program, the District uses a variety of supporting documentation to guide stream maintenance activities….Examples include BMPs, the Maintenance Guidelines, and Fish Relocation Operation Guidelines….

Chapter 2
AN OVERVIEW OF STREAM MAINTENANCE ACTIVITIES

The Stream Maintenance Program provides long-term guidance for the implementation of routine stream maintenance work. Three major types of stream maintenance activities are sediment removal, vegetation management, and bank protection. This chapter provides an overview of these stream maintenance activities and their average frequency and extent on an annual basis. Also included in this Stream Maintenance Program are minor maintenance activities described in this chapter.

The projections for work area amount under the Stream Maintenance Program are based on approximately 20 years of historical data. The numbers provided are program-level projections of future stream maintenance activities and are not intended to represent the exact extent of work which will occur in the future. As described further below, stream maintenance activities can vary from year to year. There may be some future routine maintenance activities in streams and canals within the District's jurisdiction that are consistent with the descriptions of work and impacts overall but which were not specifically included in the District's projection of work areas. Maintenance at such sites is still included in the program as long as it does not result in significant environmental effects substantially different than those evaluated for the Stream Maintenance Program as a whole.

Routine maintenance occurs on a year-round basis. However, it is scheduled to avoid or minimize impacts to environmental resources. Typically, routine maintenance that requires the operation of heavy equipment in the channel is limited to the dry season.

A. SEDIMENT REMOVAL

1. Overview

Sediment removal is the act of mechanically removing sediment deposited within a stream. Typically, sediment removal is indicated when it (1) reduces capacity, (2) prevents facilities or appurtenant structures from functioning as intended, or (3) impedes fish passage and access to fish ladders.

The District's purposes in performing sediment removal activities are to ensure that a stream will continue to provide flood capacity and to ensure that appurtenant facilities are working as designed. Sediment is usually removed from modified channels. However, sediment is also sometimes removed from natural creeks on an occasional basis to provide proper functioning of outfalls, culverts, bridge crossings, and stream gauging stations, for example. Occasionally, sediment is removed from canals to maintain their function as water conveyance facilities. Sediment is removed from canals on an irregular basis, with similar equipment used for sediment removal from streams. Based on seven sediment removal projects undertaken in canals from 1992 to 2000, the average annual

amount of sediment removed from canals is estimated to be less than 1,000 cubic yards. Sediment removal in canals takes place primarily in Almaden-Calero Canal, Coyote-Alamitos Canal, Coyote Canal, and Coyote Canal Extension.

In most cases, sediment deposition is a natural process that occurs where the stream gradient flattens out in the valley floor or where the gradient is otherwise flat over long reaches. In developed areas, this deposition affects flood flow capacities.

Typical equipment used for sediment removal includes excavators, draglines, loaders, and 10- or 20-cubic-yard dump trucks. If water must be bypassed around the site during work, water pumps and piping, and cofferdams of earth, gravel, sandbags, hay bales, rubber, or other appropriate material may be used. In some cases, a bypass channel or detention basin is appropriate to isolate a site. Saturated sediments may be temporarily placed adjacent to the work site to dry out before being removed to a landfill or to other suitable disposal or reuse sites. Most often, sediment removal projects are implemented in the dry season (summer). The District also implements BMPs to ensure that sediment removal projects have the least impact possible. The District's equipment and work methods are updated as new equipment or better methods become available. Sediment removal projects are also revised as new CIP are completed.

2. Sediment Removal Methods

The method of sediment removal is dependent on channel configuration and geometry, equipment reach and rate of production, channel type (tidal or nontidal, concrete or earth bottom), moisture content of the silt, ramp location, and access road width. For example, wide tidal reaches with a channel bottom of wet bay muds which will not support equipment require silt removal by a dragline or an excavator positioned on the top of the creek bank. This method requires wide roads for the equipment and for truck access.

Concrete-lined channels may be cleaned by pushing sediment into a pile with a bulldozer and using a loader to place the material in trucks for removal to an approved disposal site. The trucks are located at strategic points either in the channel bottom or at the top of bank depending on the method of routing the trucks. Another example is cleaning or creating a low-flow channel with excavation equipment working in the channel bottom, loading trucks either in the channel bottom or moving the sediment to trucks at the top of bank.

3. Annual Sediment Removal Activity

The District estimates that it removes an average of 80,000 cubic yards of sediment on about 16 miles of channel per year in Santa Clara County. This average includes both concrete-lined and earth-lined channels. This is an average annual quantity and will vary from year to year depending, in part, on rainfall conditions of the past season. The number of sediment removal sites each year also varies widely. Historical records show that the District removes sediment from an average of 19 sites annually but may work at as few as two sites or as many as 39 in a given year.

TABLE 2-1

[Table 2-1, which summarizes District-wide annual sediment removal activities between 1996 and 1999, is removed because it does not specifically apply to Stevens Creek. A summary of maintenance activity for Stevens Creek during the most recent fiscal year is attached.]

B. VEGETATION MANAGEMENT

1. Overview

Management of vegetation in and adjacent to creeks and canals is necessary to maintain the ability of channels to function as flood protection facilities and canals to function for water conveyance. Dense vegetation can adversely affect the ability of the channel to contain the flow of flood waters for which it was designed. Therefore, most flood protection facilities require some type of periodic vegetation control. Depending on the original design and the characteristics of the channel, the frequency of vegetation management varies from annually to every few years.

The District also plants and maintains revegetation or mitigation projects, often along creeks. In the first few years after initial planting, it is important to control weeds at revegetation sites to increase the number of native trees and shrubs which survive and to more quickly establish a self-sustaining plant community which provides wildlife habitat.

The control of invasive, nonnative plants is another purpose for which the District undertakes vegetation control. Plant species are targeted that are not native to this area of California and are known to aggressively spread. These plants can migrate into other areas where they can affect channel capacity as well as reduce native plant populations. This can lead to reduced channel capacity and overall habitat degradation. Current practice is to assign this a lower priority and do it on an ad hoc basis as it fits in with higher-priority work.

The District manages vegetation for other purposes including the protection of levees, and concrete linings from plant roots; meeting local fire codes requiring the control of combustible weeds and grasses; providing visual clearance to inspect the condition of a facility; and providing access along maintenance roads.

2. Vegetation Management Methods

Over the past 30 years, the District has continually revised vegetation management approaches to control vegetation on District facilities. This approach consists of utilizing three basic methods: hand removal (chain saws, weed-eaters, etc.); mechanical (mowing and discing); and chemical control through the use of herbicides. A method or combination of methods is chosen for each site depending on the maintenance requirements of the facility. Efficiency, economics, and the protection of public health and environmental resources are all considered in the selection of methods.

As an example, herbicides can often be a more effective vegetation control method when compared to mechanical or hand removal. This is because of their ability to spread into and damage the roots of the target plants, thus preventing resprouting. When treated with mechanical or hand methods, some woody plants, such as willows, will resprout with multiple stems. The multiple sprouts result in a greater flood protection problem and require annual control. With herbicides, annual retreatment is often necessary; however, the treatment area is greatly reduced, as only a small percentage of regrowth will occur. As a result, this program includes herbicides as the primary method by which vegetation is controlled in channels and on streambanks.

Herbicides are not broadcast sprayed across the channel, but are selectively sprayed at the plants targeted for removal by the design parameters of each particular stream reach. In some streams, only woody saplings (no greater than 2 inches in diameter at breast height) are removed in the target area, while other streams require removal of both herbaceous and woody vegetation. In upland areas, herbicides are sprayed on maintenance roads to provide a clear access area and on levee slopes to eliminate broadleaf weeds.

The District only uses herbicides according to the label directions and for uses approved by the United States Environmental Protection Agency (USEPA) and the California Department of Pesticide Regulation (DPR). Currently, the primary postemergent herbicides which the District uses are Roundup® Pro and Aqua Master® (formerly known as Rodeo®). These herbicides are formulations of the chemical glyphosate, which is a nonselective broad spectrum herbicide. Aqua Master® is approved for use in aquatic areas, whereas Roundup® Pro is not approved for application directly in water or to areas where surface water is present. Other herbicides which will be used by the District are shown in the following table.

TABLE 2-2

Herbicide Use for the Multiyear Stream Maintenance Program

Product Name	Chemical Type	Use	Average Annual Amount
Gallery	Isoxaben	Preemergent, selective to broadleaf weeds. Used on levee slopes and maintenance roads.	447 pounds
Garlon 3A	Triclopyr, triethylamine salt	Postemergent, selective to broadleaf weeds. Used on levee slopes.	5 gallons
Garlon 4	Triclopyr, triethylamine salt	Postemergent, selective to broadleaf weeds. Used on levee slopes.	62 gallons
Oust	Sulfometuron	Preemergent, nonselective. Used on access roads/firebreaks.	206 ounces

Pendulum	Pendimethalin	Preemergent, selective to grasses. Used on access roads/firebreaks.	3,576 pounds
Aqua Master (formerly known as Rodeo)	Glyphosate	Postemergent, nonselective. Approved for aquatic use. Used in channels.	750 gallons
Roundup Pro	Glyphosate	Postemergent, nonselective. Roundup used in upland areas on maintenance roads/firebreaks.	1,021 gallons
Surflan (AS)	Oryzalin	Preemergent, selective to grasses. Used on access roads, firebreaks, and landscape/ revegetation areas.	1,269 ounces
Telar	Chlorsulfuron	Preemergent, selective to broadleaf weeds. Used on levee slopes and maintenance roads.	2,140 ounces
Transline	Clopyralid	Postemergent, selective to specific broadleaf families. Some minor preemergent activity. Used for control of yellow star thistle on levee slopes/upland parcels.	16 gallons
Target Pro-spreader/ activator or Wilbur-Elias R-11 spreader activator		Surfactant used with Aqua Master®, Garlon, and Transline products.	310 gallons

In total, the District currently uses approximately 2,000 gallons of herbicides, 50 percent of which is Roundup® Pro and 35 percent is Aqua Master®. In addition, the District uses approximately 3,580 pounds of Pendulum and 450 pounds of Gallery per year. Appendix H contains a literature review of pesticides used by the District.

The Stream Maintenance Program includes the reinstatement of the use of herbicides as part of the Vegetation Management Program in the Pajaro River Basin. Herbicides are currently used as part of the Vegetation Management Program in the Santa Clara Basin, but their use was discontinued in the Pajaro River Basin (South County) at the direction of the District Board of Directors in 1974 because of complaints regarding drifting of herbicides into agricultural fields. In 1979, the District considered reinstating a herbicide program in the Pajaro River Basin. At that time, there was a general concern in the community over the use of herbicides, particularly the use of 2,4-D, and after public hearings, the District decided not to reinstate the use of herbicides in the Pajaro River Basin. As a result, the use of herbicides was also excluded on new federally-sponsored flood protection projects on Llagas Creek in the Pajaro River Basin.

Since that time, the District has revised its herbicide program to address environmental, health risk, and public safety concerns, but at the same time recognize that herbicides are a cost-effective means for maintaining flood protection and water supply facilities. Many of the improvements made to the District's herbicide program are described below:

- In 1980, the District discontinued the use of the herbicide 2,4-D.

- In 1986, the District switched to using herbicides in the sulfonylurea family which are applied at rates of ounces per acre, rather than previous herbicides which were applied at rates of pounds per acre. This step not only reduced the overall amount of herbicides being applied throughout the county, but also relied on using herbicides with a lower toxicity.

- In 1988, the District went beyond state requirements and required all District employees who handle pesticides to be certified as Qualified Applicators by the DPR. As Qualified Applicators, these employees are trained on pesticide laws and regulations, safety, and application methods and are required to receive annual training to keep updated in this field.

- Likewise, even before state requirements, the District required that a District Pest Control Advisor (PCA) prepare a pesticide use recommendation for any use of herbicide on District facilities. For the District's purposes, PCAs are required to have a relevant bachelor's degree, be trained in integrated pest management and groundwater protection, and continue to receive 40 hours of relevant training every 2 years.

- At the District, the PCA is required to conduct a field survey to assess the site conditions, types of weeds and nontarget plants, surrounding land uses, and potential wildlife use prior to writing a pesticide use recommendation. This information is used to make a recommendation with detailed instructions to the applicator regarding the type of herbicide, rate, equipment, treatment area identified on a map, target vegetation, vegetation to protect, and any special instructions relevant to the site and treatment.

- Certain types of herbicides were found as contaminants in groundwater in California's Central Valley. Although no restrictions were placed by the state on their use in Santa Clara County or on soil types found in Santa Clara County, the District voluntarily discontinued the use of certain preemergent herbicides on our facilities in 1993 to avoid any potential problems with groundwater. This practice continues today. PCAs receive groundwater training every 2 years from the DPR and receive routine updates in changes to the regulations. Though none of the regulations currently apply to this county, the District discontinues use of products that are known groundwater contaminants in other areas of the state.

- In 1994, the District voluntarily eliminated the use of residual preemergent herbicides on our groundwater recharge facilities. Today, only herbicides that are registered for use in aquatic areas are used at these locations.

- In 1996, the District retrofitted its spray trucks to include the Patchen WeedSeeker. This device utilizes a light sensor attached to the front of the spray equipment that detects the presence of chlorophyll (and, therefore, living plants) and controls individual spray heads. Instead of spraying the entire width of a facility as the spray truck passes over it, individual spray heads are turned on only as they pass over vegetated areas. This eliminates the treatment of bare ground and reduces the amount of herbicide applied by 20 to 90 percent. This equipment is primarily limited to use on flat areas where all vegetation needs to be controlled, such as maintenance roads.

- The District currently uses primarily Category III and IV herbicides. Under a ranking system developed by the USEPA, pesticide products are given an acute toxicity rating which is reflected in the warning label of the pesticide container. Category III is considered slightly toxic ("caution" warning on label) and Category IV is considered practically nontoxic (no warning language included on label).

As a result of these improvements, the District is now proposing that herbicide use be reinstated in the Pajaro River Basin. This change would require the following actions:

- The District's Board will need to adopt implementation of the Stream Maintenance Program, changing the maintenance practices in the Pajaro River Basin to include herbicides as a routine maintenance tool.

- The maintenance documents for the federally-sponsored Llagas Flood Protection Projects (PL-566 projects) will require amendment by the federal sponsoring agency, Natural Resources Conservation Service (NRCS), to include this activity.

Staff has been working with the Board and NRCS toward the implementation of this change. Both the Board and the NRCS agree this is a beneficial change.

Hand removal of vegetation is undertaken in a few locations where it is not possible to access the area with spray equipment. In some cases, the vegetation is sprayed with herbicides, and then approximately 6 months later, the dead material is removed by hand removal methods, if necessary. This latter category of work is referred to as follow-up hand removal. Follow-up hand removal of vegetation is only necessary when herbicide spraying is new to an area and there is a larger volume of dead vegetation created in the first year or two. In subsequent years, the amount of vegetative regrowth is reduced and follow-up hand removal is necessary much less frequently.

The five types of vegetation management in upland areas are: discing, mowing, herbicide application, hand removal, and removal of overhanging growth to provide maintenance access.

Upland discing occurs on upland parcels outside of the streambanks and is conducted to create firebreaks. Upland mowing consists of operating a flail mower to eliminate or reduce grasses that would cause a fire hazard during the summer. Mowing can occur

from one to three times annually at each location, usually between May and October. Mowing is conducted on the inside slope of streambanks and outboard levees slopes to create a firebreak.

Upland herbicide spraying is used on levees, unpaved maintenance roads, and along some property lines. On levees, herbicides are used primarily to keep woody vegetation and broadleaf weeds from becoming established where they will interfere with flood flow capacity, damage the levees, or hinder their inspection. Weeds and grasses are sprayed on maintenance roads to clearly define and keep open the access route. Herbicide spraying along property lines assists in establishing a firebreak. Pre and postemergent herbicides are sprayed from a truck-mounted rig or by a controlled drop applicator.

Hand removal of vegetation is conducted in upland areas where mowers cannot access, and herbicides are either not practical due to steep terrain or not allowed. Hand removal of vegetation is generally used in upland areas along property lines to establish fire breaks. Removal of overhanging growth consists of pruning trees branches that impede access roads or hang over fence lines.

3. Annual Vegetation Management Activity

The frequency of vegetation management activities varies from semiannually to once every several years, depending on the method used. Herbicide spraying in stream channels is conducted July 1 through October 15. Removal of woody vegetation by hand is conducted July 1 through March 1. Hand removal in stream channels is conducted November through December.

Vegetation management occurs in creeks, canals, and adjacent uplands. On average, vegetation management work is annually performed on approximately 4,000 acres. Within this larger work area, the targeted treatment area consists of approximately 2,000 acres. These totals include the following approximate levels of activity:

- 923 acres of vegetation management work is conducted in 222 miles of stream channels with 132 acres of the total actually receiving treatment (585 work acres or 75 acres of treated area on 166 miles in the Santa Clara Basin, and 338 work acres or 57 acres of treated area and 56 miles in the Pajaro River Basin);

- 23 acres on which vegetation management work is conducted on 27 miles of canals with 6 acres of the total actually receiving treatment; and

- 3,021 acres of uplands on which vegetation management work is performed, with 1,885 acres actually receiving treatment. Upland vegetation management is outside of the area of inundation, and generally has a buffer of grass or vegetation on the slopes between the right of way and the stream.

Vegetation management activities are relatively the same from year to year. Slight variations in flood protection activities occur due to weather patterns. For example, historically, increases in some work activities occur during flood years, with decreases in

other activities occurring during extended periods of drought. Right of way activities remain constant regardless of these weather patterns.

C. BANK PROTECTION

1. Overview

Bank protection involves an action by the District to repair streambanks that are eroding or are in need of preventative erosion protection. The District implements bank protection when the problem (1) causes or could cause significant damage to a property or adjacent property, (2) is a public safety concern, (3) negatively affects transportation or recreational use, (4) negatively affects water quality or beneficial uses, or (5) negatively affects riparian habitat. Repairs may take several forms from installing "hard" structures (e.g., rock, concrete, sack concrete, gabions) to "soft" structures (e.g., willow brush mattresses, log crib walls, pole plantings) or a combination of hard and soft structures.

Streambank erosion is a natural process, which mostly happens during major storm events. Erosion can occur because of hydraulic forces and geotechnical instabilities, and can be accelerated by human intervention and land uses. Accelerated erosion is typically a result of particular land uses that affect the stream corridor, including grazing, agriculture, and road and utility construction. Erosion of banks can result in increased sediment deposition, which can lead to decreased flood flow capacities and potential flood hazards. Erosion on banks may also cause vegetation and soil loss, damage to private or public property, transportation and utility impacts, safety hazards, and turbidity injurious to fish and aquatic life. Levee erosion may lead to failure of the structure and flooding.

Bank protection work may either occur as repair of an existing bank protection project which is failing, or as new work along a bank which is eroding. The new work is considered routine maintenance because it is either restoring the flood protection function of a modified channel or it is repairing a natural bank to its approximate condition prior to becoming an erosion problem.

Repair of existing bank protection structures occurs when these structures fail and are replaced with in-kind, in-place materials. New bank protection projects are those that repair or protect the watercourse from further degradation or erosion using the most appropriate method. This type of protection is considered maintenance if the work does not significantly alter the flood conveyance capacity of the streams.

Equipment used for bank protection may include excavators, dozers, cranes, loaders and 10- and 20-cubic-yard dump trucks, concrete trucks, and pumps and water trucks. If water must be bypassed around the site during repair work, water pumps and piping, and cofferdams of earth, gravel, sandbag, hay bales, rubber, or other suitable material may be used. In some cases, a bypass channel or detention basin is appropriate to isolate a site. Most often, bank protection projects are implemented in the dry season.

2. Bank Protection Methods

The general design criteria and plan for each of the bank protection methods used by the District are included in Appendix E [which is not included for brevity, but is available upon request]. In addition to these criteria, design of a particular bank protection project includes evaluation of other site-specific characteristics such as bank slope, shear stress, location (such as the inside or outside of a curve), soil type, flow velocity, characteristics of the channel adjacent to the site, and the available right of way. The site is evaluated for the repair method consistent with the characteristics of the site. Revegetation potential is also evaluated for each bank protection project. This potential is not only dependent upon the method of bank protection used, but also the physical properties of the stream where the repair is taking place.

In natural stream conditions where there are no flow capacity requirements, vegetation components for streambank repair are selected. In modified creek channels where the flow requirements must be retained (such as for the 100-year flood), this will often necessitate a roughness maximum which, depending on the channel design, may limit the vegetation component of the design.

A range of methods is used for bank protection, as can be exemplified by several District bank protection projects. Many of the following examples demonstrate how soft methods can be combined with harder methods when site conditions cannot maintain a purely natural solution.

- Log crib walls were used on Guadalupe River, downstream of Coleman and downstream of Woz Way and on Bodfish Creek upstream of Santa Teresa.
- Earth repairs with vegetated slopes were included in the Princevalle storm drain downstream of Chestnut, Sunnyvale East Channel downstream of Evelyn and Lower Penitencia Creek, downstream of Redwood Drive.
- Rock hybrids include Permanente Creek at Lundy Lane, Stevens Creek downstream of Fremont, and Los Gatos Creek downstream of Bascom Avenue.
- Cottonwood seedlings growing on articulated concrete mats are located on Guadalupe River upstream of Highway 880.

For all bank protection projects, the District makes an inspection of the stream upstream and downstream of a project site to determine if there is an identifiable cause of the erosion. In some cases, the cause of erosion is obvious, such as a blockage (e.g., downed tree) or weak streambanks of silt or gravel stratas. In other cases, a further inspection is conducted to determine if flows are being directed toward the bank from a source upstream, whether the channel invert is down cutting, or if illegal drainage is causing the problem. These factors can affect the bank protection approach implemented by the District.

3. Annual Bank Protection Activity

The District estimates that an average of 5,000 linear feet of banks may be repaired annually based on historical records, District experience, and current levels of funding. This is an average annual quantity and will vary from year to year. Facilities are inspected after the winter storms for damage and maintenance needs and a work plan is prepared. Under the Stream Maintenance Program, the District is committing to installing no more than 50 percent of future bank protection work using hardscape designs.

In the past 14 years, the total length of bank protection activities in an individual year ranged from approximately 1,500 to 13,000 feet. The District has completed an average of 38 bank protection jobs per year, based on historical records, but there is considerable deviation. For example, there were nine jobs in 1994 and 73 in 1987. A more detailed summary of historical bank protection activities is provided in Table 2-3.

TABLE 2-3

[Table 2-3, which describes bank protection activies from 1987-1999 is removed for brevity, because it does not apply specifically to Stevens Creek.]

Unlike sediment removal and vegetation management, the historical location of bank protection activities is not a good predictor of where future bank protection will be required. The quantity and location of bank protection activities varies greatly from year to year, based upon watershed conditions, degree of safety hazard, work load, budget, and of other work to be done in a given year.

D. MINOR MAINTENANCE ACTIVITIES

Minor maintenance activities included in this Stream Maintenance Program are: trash removal at trash racks and more generalized locations; repair and installation of fences and gates; grading and other repairs to restore the original contour of access roads and levees; grading small areas without vegetation above streambanks to improve drainage and reduce erosion; repair of structures with in-kind materials within the same footprint (such as replacement of concrete linings, culverts, pipes, valves, or similar structures); cleaning and minor sediment removal at stream gages, outfalls, culverts, flap gates, tide gates, inlets, grade control structures, fish ladders, and fish screens; graffiti removal; tree pruning along maintenance roads and fence lines to provide access and to remove hazards; irrigation, weeding, replanting, and other types of ongoing maintenance at mitigation sites; removal of obstructions to flow in the immediate vicinity (not to exceed 100 feet) of bridges, streamflow measuring stations, box culverts, storm drain outfalls, and drop structures to maintain functions of such structures; removal of trees or branches that are in imminent danger of falling, fallen trees, and associated debris to maintain channel design capacity; and ground squirrel and rodent control with traps, smoke bombs, and pesticides.

PERMITS

The following regulatory permits have been obtained for routine maintenance activities that fall under the Stream Maintenance Program described herein, including activities on Stevens Creek. The actual permits are available upon request or may be downloaded from the following site:

http://www.valleywater.org/Water/Technical_Information/Technical_Reports/index.shtm#smp

Bay Conservation and Development Commission
California Department of Fish and Game
Central Coast Regional Water Quality Control Board
United States Army Corps of Engineers
National Marine Fisheries
San Francisco Regional Water Quality Control Board
United States Fish and Wildlife Service